The Chemical Age

OL LXV 11 AUGUST 1951 No 1674

INDEX TO ADVERTISERS IN THIS ISSUE

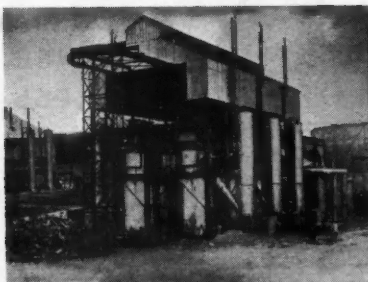
	Page
Bamag, Ltd.	205
British Acheson Electrodes, Ltd.	xii
British Iron & Steel Federation	xi
Brough, E. A., & Co., Ltd.	vi
Chemapol, Ltd.	iii
Classified Advertisements	208, xvii
Cole & Wilson, Ltd.	207
Cruickshank, R., Ltd.	Cover ii
Cygnet Joinery, Ltd.	iv
Drayton Regulator & Instrument Co. Ltd., (The)	xiii
Finney Presses, Ltd.	viii
Foyle, W. & G., Ltd.	xviii
Gas Council (The)	v
Geigy, Ltd.	xiv
Guest Industrials, Ltd.	x
Haughton's Metallic Co., Ltd.	207
International Pulverisers, Ltd.	Cover iii
Kestner Evaporator & Engineering Co., Ltd.	vi & xviii
Key Engineering Co., Ltd. (The)	Cover ii
Leigh & Sons Metal Works	xviii
Leitch, John W., & Co., Ltd.	iv
Lennox Foundry Co., Ltd	xviii
Lord, John L.,	Cover iv
Metafiltration Co., Ltd. (The)	Cover ii
Metropolitan-Vickers Electrical Co., Ltd.	Cover iv
Metway Electrical Industries, Ltd.	viii
Mirrlees Watson Co., Ltd. (The)	x
Mitchell, L. A., Ltd.	x
Muirhead & Co., Ltd.	i
P. & H. Phosphates, Ltd.	xvi
Philips Electrical, Ltd.	xv
Powell Duffryn Carbon Products, Ltd.	ix
Power-Gas Corporation, Ltd. (The)	vii
Senior Economisers, Ltd.	Front Cover
Shawinigan, Ltd.	Cover iii
Simon, Richard, & Sons, Ltd.	xviii
Steele & Cowlishaw, Ltd.	207
Stewart & Gray, Ltd.	xiv
Streamline Filters, Ltd.	Cover iii
Ward, Thos. W., Ltd.	ii
Wilkinson, James, & Son, Ltd.	xii


are easy pouring


BROUGH'S
K.C.C. DRUMS

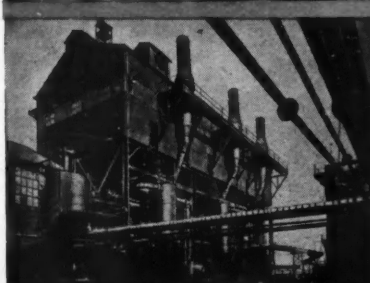
THE DESIGN & MANUFACTURE OF PLANT

FOR THE PRODUCTION, COOLING, PURIFICATION & PROCESSING OF INDUSTRIAL GASES



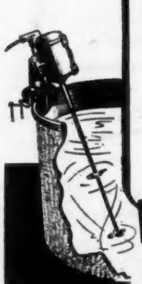
A six unit P.G. Producer Gas Plant gasifying wood logs.
INDIA

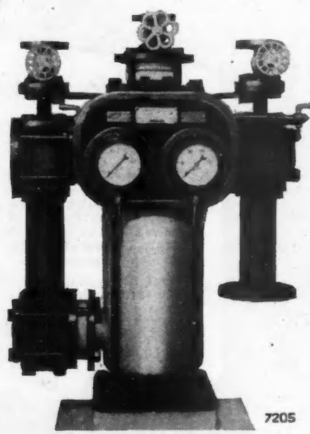
A four unit P.G. Semi Water Gas Plant using Oxygen and gasifying coke.
HOLLAND



A three unit P.G. Semi Water Gas Plant gasifying coke.
SOUTH AFRICA

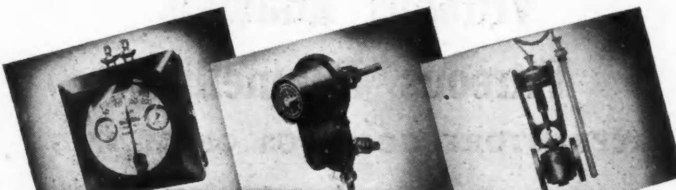
THE POWER-GAS CORPORATION LTD.
(ASSOCIATED WITH ASHMORE, BENSON, PEASE & CO., LTD.)
STOCKTON-ON-TEES AND LONDON
AUSTRALIA CANADA INDIA SOUTH AFRICA





If it's a question of CONTROL

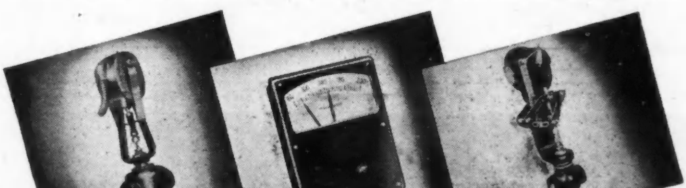
Correct selection of equipment is of supreme importance. Expenditure on regulators not suitable for the job can be a dead loss in itself, as well as jeopardising production. DRAYTON do NOT concentrate on one type of control and can therefore advise impartially and from the widest experience. Tell us your problem or write for the Drayton Catalogue.



Air operated proportioning type regulator with or without re-set.

Simple air or water operated regulators for temperature or pressure.

Self-operating regulators for simple control applications.

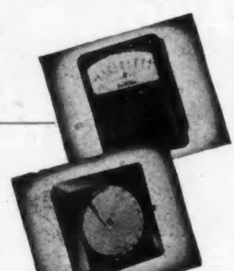


Motor-operated valve for use with wide range of Drayton automatic switches for on-off control.

Proportional electric Control for constant temperature or indoor/outdoor control of heating plant.

Combined thermostatic switch and temperature indicator.

Drayton Indicating & Recording Instruments for temperature, pressure and draught. Made to the same high instrument and engineering specifications as Drayton regulators.



DRAYTON

will advise you!

THE DRAYTON REGULATOR & INSTRUMENT CO. LTD.
WEST DRAYTON · MIDDLESEX (*West Drayton 2611*)

AC13

The
Chemical Age

Established 1919

The Weekly Journal of Chemical Engineering and Industrial Chemistry

BOUVERIE HOUSE 154 FLEET STREET LONDON E.C.4

Telegrams: ALLANGAS FLEET LONDON · *Telephone:* CENTRAL 3212 (26 lines)

Volume LXV 11 August 1951 Number 1674

Higher Technological Education

AFTER nearly 10 years of examination and report the future pattern of higher technological education in Great Britain still remains undetermined. The three national committees, the Percy, Barlow and Tizard committees, all advocated that the national need could be met by Colleges of Technology. While the Tizard committee suggested that such colleges should be under the ægis of the University Grants Committee, the Percy and Barlow reports recommended that they should be given the necessary status and finance to permit them to develop as Colleges of Technology of university rank themselves. In 1948 the National Advisory Council for Education in Industry and Commerce, which was appointed by the Ministry of Education, proposed that a Royal College of Technology should be formed to make awards in technology comparable with university degrees. Finally, a number of advocates exist who support the idea of a Technological University or universities, on the lines of the Massachusetts Institute of Technology.

The Parliamentary and Scientific Committee, which does much useful and little publicised work, seems fully to appreciate that the continued lack of decision on this matter is highly unsatisfactory and that some early pronouncement from the Government is called for. Technology is not getting its fair share of the best brains of the country. In the United Kingdom technology is still placed by most people behind pure science, a strong contrast to America, where the two are considered on a basis of equality. While proposals for a Royal College of Technologists received a good deal of support, there have been several dissentients.

Some sound arguments against the projected Royal College were put forward by Dr. David S. Anderson, A.R.T.C., M.I.Mech.E., director of the Royal Technical College, Glasgow, who emphasised that in his personal opinion he had the gravest doubts as to its success. Any decision now is vitally important as it may well set the pattern for the next 25 years. The doctor contended that the success of the Royal College of Technologists would entirely depend on the new awards being recognised by all concerned as equivalent to university degrees. If this was not so, students would not be attracted to technology any more than at present—and, in fact, failure would only make the position deteriorate by giving technology a permanent stigma of inferiority. Among the weakness of the scheme, one

would appear to be the analogy of comparing the Royal College with the Royal Society, and the Royal College of Surgeons, a small, clearly defined homogeneous professional body. The proposed Royal College of Technologists is neither one nor the other. It is a particular type of professional activity undertaken by men of many different professions—chemistry, engineers, physicists, textile specialists, and so on—it cannot therefore be regarded as a homogeneous body. Neither can it function as a learned society as its main duty is to control courses of examination and promote higher technological education.

The technologies to be covered would be numerous, and would include civil, mechanical, electrical, chemical, mining, and aeronautical engineering, metallurgy, applied chemistry, including rubber, ceramics, plastics, applied physics, pharmacy, textiles, architecture, and building. Courses in all these already exist, and all would claim inclusion in the scheme. In every branch quoted, a professional institution already exists. A heterogeneous body, such as the Royal College of Technologists, could never achieve in any particular field the authority of the corresponding professional institution, and, if it attempted to do so, it would fail. Every professional institution has the promotion of education as one of the objects of its charter, and, therefore, the danger of overlapping activities and even divergent policies is quite real. While the new college would start with the highest standards in view and the intention of limited recognition, it seems almost inevitable that the 50 colleges now doing some measure of advanced work would all hope for inclusion. With the extension of the field of recognition the standard would decline. There are neither enough students nor teachers of the high calibre required to conduct courses in 40-50 colleges. An award obtainable in one of so many colleges would not, of course, compare with a degree in one of 13 universities.

Whatever views are held on this important subject two important points are universally agreed. First that the technical colleges must have freedom—freedom to teach according to the best academic standards, and freedom to spend the money available to the best advancement of the technology the college is teaching. Secondly, some action must be taken quickly to supply the lack of technologists who alone can put into practical form the discoveries of the research workers and the scientists. There is an urgent need for men who can assess the scientific basis of a new discovery and carry it right through to the production stage. The question of finance is a serious one for the Chancellor of the Exchequer recently stated in regard to education that there would be some increase in the capital investment programme on education, but that there would have to be some reduction on the amount proposed to be spent a year ago. It is sincerely to be hoped that this reduction will not affect any plans for the future of higher technological education, for on this expenditure depends the future prosperity of the country.

On Other Pages

The Advance of Science	179	*Magnetic Oxygen Recorder*	195
'Il Faut Cultiver Notre Jardin'	181	*Home News Items*	198
The Changing Face of Chemical Industry	186	*Overseas News Items*	199
Shortage of Scientific Man-power	187	*Personal*	200
Corrosion Prevention	189	*Chemist's Bookshelf*	201
Defence of Profits & Dividends	189	*Publications & Announcements*	203
		Commercial Intelligence	206

The annual subscription to THE CHEMICAL AGE is 35s. Single copies, 9d.; post paid, 1s.; SCOTTISH OFFICE: 116 Hope Street, Glasgow (Central 3970). MIDLANDS OFFICE: Daimler House, Paradise Street, Birmingham (Midland 0784-5). THE CHEMICAL AGE offices are closed on Saturdays in accordance with the adoption of the five-day week by Benn Brothers, Limited.

Notes & Comments

The Layman and Science

THE Duke of Edinburgh, speaking as this year's president of the British Association for the Advancement of Science, in the opening of his address at the inaugural meeting in the McEwan Hall, Edinburgh, emphasised that he spoke as a layman, and urged the vital need of a full and clear understanding of scientific development not only by the scientist, but also by the layman. No more appropriate centre than the city of Edinburgh could have been chosen for this year's Festival meeting, for it has played a prominent part in promoting the interests of science. Even before the formation of the British Association, Andrew Duncan, Professor of Materia Medica in Edinburgh, was impressed in 1829 by the benefits accruing in Heidelburg from an association of men of science and those interested in its application. Two years later, probably inspired by the German example, Sir David Brewster, writing in the Edinburgh Journal of Science, advocated the value of a similar association in Britain. His suggestion was acted upon, and the first meeting of the British Association was held at York in the same year, 1831. From the start, Edinburgh had shown a keen interest in the new body, and the fourth meeting was held in the city in 1834. Sir Edward Appleton, principal of Edinburgh University, speaking recently, also advised the layman to take more than a passing interest in science. It was the layman, who by his needs, influenced the particular field of research to be explored. Despite its early struggles, the 'British Ass,' as it is popularly called, is now deservedly held in universal esteem. The association is unique in its service to the scientist and the ordinary citizen. It offers, in language not confined to the specialist, discussion of a host of problems which are the intimate concern of us all today, besides affording the opportunity of reading their papers to young men in the chemical, engineering and other of the nation's important industries.

A Scientist's Responsibilities

SIR CYRIL HINSHELWOOD'S presidential address to the chemical section of the British Association on Thursday morning contained, as we have come to expect from this outstanding man, far more than is confined within the technical limits of the subject of chemistry. Chemistry in its wider form links us with the processes of life itself, and poses problems as difficult as any to solve. The problems have been with us ever since the Chinese invented gunpowder, but they more urgently need solving today because not to solve them threatens annihilation. Sir Cyril embarked on the controversial question of responsibility for this state of affairs. Rightly he points out that scientists cannot be blamed if their search for truth is prostituted by the layman and used by him for purposes of destruction. Every advance in any kind of knowledge brings an equivalent power for good or for evil with it, and which it is to be is governed solely by the people who use it, not the people who discover it. This probably brings cold comfort to the ordinary mortal, who neither discovers nor uses it, but sits in a kind of scientific no-man's-land waiting for the first hydrogen bomb to be dropped and the first whiff of the latest nerve-paralysing gas to be pumped down to him. He, like the defiant pedestrian who was just as dead as if he had been in the wrong, is not likely to care very much who is responsible if the time ever does come. Nevertheless, it is not the search for truth that brings these evils into the world, but the search for power.

This situation offers a special problem to scientists. Having brought knowledge into the world they not unnaturally seek to influence the people who are going to use it. The difficulty with this, however, is that the mind that is primarily interested in knowledge and the search for truth is, by virtue of its own training, often different to the mind that has to deal with inexact, biologically variable and frequently inconsistent human beings. There is no scientific approach

to compromise, and scientists sometimes forget that persuading a number of human beings to go the same way is not at all the same thing as manipulating reactions in a laboratory. When it comes to human problems they are unfortunately no better qualified than anyone else untrained in the subject, and when it comes to dealing with the power politicians that are the scourges of this age, their limitations often become even more apparent.

New Chemical Stamp

ON 4 September a new American stamp will commemorate the founding of the American Chemical Society. This cannot be claimed as the first example of postal honour to chemistry, for chemists have now made quite a few philatelic appearances. There was the Pasteur stamp of 1923 in France and 20 years later the same country issued a Lavoisier commemorative stamp; Nobel and Berzelius have appeared on Swedish stamps. The new United States issue seems to be the first stamp actually paying honour to a chemical society, though Russia in 1945 issued two commemorative stamps to mark the 220th anniversary of their Academy of Sciences. The design is most appropriate for the occasion, showing a group of modern laboratory instruments, a butadiene reactor, the towers of a cracking plant, and a fractionating unit. In the centre is the society's emblem. Like most of the United States' commemorative issues, it will be a three cent stamp. The colour has not yet been officially announced, but there is no truth in the disrespectful rumour that it will be litmus-dyed and turn red when licked by acid tongues and blue for the more alkaline! As the British philatelic journal, *Stamp Collecting*, has pointed out, the stamp carries a 'howler' that will be perpetuated for all time in collectors' albums. The anniversary is stated on the stamp to be a Diamond Jubilee and the dates given are 1876-1951. Though the structure and creation of diamonds has long been a problem to chemists, there is surely no uncertainty about diamond jubilees. They are sixtieth anniversaries and always have been. The American Chemical Society reached that particular milestone in 1936.

German Scrap Question

THE important question of whether this country is to get adequate steel scrap supplies from Germany has not been made any more hopeful by a statement by a German Government spokesman recently that Britain's latest proposals for deliveries were unacceptable. These proposals were for an increased effort in the Federal Republic to collect steel scrap, from which the first 300,000 tons was to be retained for the German economy, the next 50,000 tons to be allocated for export, and the remainder to be divided equally between export and home consumption. The British High Commission maintains that scrap is not being collected as thoroughly as it might be, but even so, a scrap collection in Germany of 450,000 tons a month as estimated by the Federal Ministry of Economics would result in a shipment of 30,000 tons a month to Britain, while the Germans have only offered us 10,000 tons a month during the second half of this year.

The Ministry of Economics also made it clear that Germany does not recognise a special obligation to deliver a fixed amount of scrap to Britain in future. Moreover it admits a deficit of only 7,000 tons on deliveries promised to Britain up to the end of June, compared with a British figure for the deficit of 90,000 tons. The Germans say that this deficit should be made good, but that this could equally well be done by monthly deliveries. Meanwhile, both Allied and German quarters say that the scrap question alone is holding up the signing of the new trade agreement between Great Britain and Western Germany. The old one expired on 31 March, so that the scrap controversy therefore has already caused a hiatus of four months. Negotiations for the signing of the new agreement are still going on in Bonn.

British experts point out that Germany exported 171,000 tons of scrap to Britain in 1949 and 137,000 tons in 1950. In the first half of this year the figure dropped to 44,000 tons a month.

The Advance of Science

Britain's Contribution in the Past 100 Years

An abstract of the presidential address by the Duke of Edinburgh at the 113th annual meeting of the British Association for the Advancement of Science which began in Edinburgh this week.

'YOUR kind invitation to me to undertake the office of your president for the ensuing year could not but startle me on its first announcement. The high position which science occupies, the vast number of distinguished men who labour in her sacred cause, and whose achievements, while spreading innumerable benefits, justly attract the admiration of mankind, contrasted strongly in my mind with the consciousness of my own insignificance in this respect.'

These words used by his great-great grandfather, the Prince Consort, who held the office of president in 1859, were quoted by the Duke of Edinburgh at the opening of his presidential address on 'The British Contribution to Science and Technology in the Past Hundred Years.'

Saying that he did not feel that he could improve on this, the Duke continued that he had come to the conclusion that it was as an outsider or layman that he might perhaps be useful. The very invitation showed that science was not a magic circle, but rather that the confidence of everyone was invited. In return he would like to express the public appreciation of the work of scientists and give a layman's impression of the march of science in the last hundred years.

Industrial Expansion

In a review of British science and technology, 1851, is a convenient starting point for two reasons. Firstly, the Exhibition of that year could be regarded as a gigantic stocktaking of the national resources and technical skill. Secondly, because it marked the end of the Industrial Revolution and the conversion of Victorian England to the policy of industrial expansion on which our future still depends.

The period as a whole saw the climax of our industrial supremacy and its inevitable decline when countries with greater re-

H.R.H. The Duke of Edinburgh

sources and population learned from us the lessons of the mechanisation of industry. It also covers the birth and growth of the new concepts of modern science.

This was the age of the practical engineer and of processes arrived at by intuition born of experience and by trial and error. Technology was concerned with the application of steam power, with metallurgy and the working of metals for various purposes, and with the production of machine tools and precision machinery. Men were already turning their minds to other types of engines and the internal combustion engine was in process of development.

Scientists, while continuing their search for the secrets of nature, were beginning to turn their attention to exploring the empirical developments of industry. Their numbers as yet were small, the endowments for research were negligible and much of their work was carried out in the watertight compartments of the different sciences. But the seed had been sown and it was not long before scientists and engineers were preparing the way for the great technological harvest of the 20th century.

For the next 50 years science advanced rapidly but in most fields there was a wide gap between science and industry. Electricity was an exception and the groundwork was already being laid for the electrical revolution of the Victorian age.

New factories and plants, mainly the result of British genius, were being built, and with the expansion of industry came the demand for new ideas and greater effiicency. This was a direct stimulus to technological invention as well as an indirect one to science.

In 1914 the first World War brought a realisation of the part science must play in the industrial and military strength of the nation. For the first time in history a real attempt was made to enlist the services of science in the war effort and the Department of Scientific and Industrial Research was formed to further the application of science in industry through Government laboratories and research associations. The effects of these measures appeared clearly in the years between the wars.

Commercial Laboratories

Scientific progress was no longer confined to the work of a few brilliant individuals, but came also from teams of research scientists each working on different parts of the same problem. It was during this period that many new commercial research laboratories grew up, employing scientists to discover new processes and materials connected with their industry.

The war had also shown a weakness in dependence on foreign production for many vital articles, such as dyestuffs, scientific instruments and optical glass, in the manufacture of which scientific research played an essential part. Introduction of the Key Industries Duty gave much support to the establishment of these industries at home.

This was a period of rapid development in Britain. In the electrical, chemical and aircraft industries science was fully enlisted in the fields of electronics, synthetic fibres, plastics, aerodynamics and light alloys. Consequently, the outbreak of war in 1939 found the country in a much stronger position to meet the immense demands it made on all branches of technology. These demands once more revealed where industrial capacity was out of date.

Our industry and productivity have shown a wonderful improvement, but there is still a lot more that can be done. The rate at which scientific knowledge is being applied in many industries is too small and two slow. Our physical resources have dwindled, but the intellectual capacity of our scientists and engineers is as great as ever, and it is upon their ingenuity that our future prosperity largely depends.

The Duke went on to pay a tribute to some of the great men of science of the last hundred years.

Chemistry, he said, has fascinated man from the earliest times, and vast progress has been made in the last hundred years both in knowledge and theory. Much fresh ground was broken by Crookes by his work on spectra, his discovery of thallium and of 'radiant matter' known later as cathode rays. Long after everyone was quite sure of the composition of the air, Rayleigh found another ingredient which he called argon and so started the hunt for other inert gases.

In organic chemistry both Perkin and Robinson have added enormously to our knowledge of the structure of carbon compounds, and to our power to copy natural products synthetically.

Development of X-ray analysis by the two Braggs, father and son, has given us a means of finding the actual arrangement of the atoms in the molecule and has revealed the accuracy of the chemists' conclusions about the architecture of molecules based on their reactions with one another. This is a most striking example of the power of the theoretical and practical scientist to penetrate nature's secrets.

The Atomic Nucleus

Going beyond the chemist and his molecules we come to the physicist and the study of even smaller particles. Thomson's discovery of the nature of the electron was the first attack upon the integrity of the atom. Next, thinks to Rutherford's brilliant research and keen intuition, came the nuclear theory which revolutionised our ideas of matter.

Technological developments in metallurgy were also mentioned by the Duke, who, continuing his survey, also named some of the pioneers in mechanical engineering, flying, electronics, radio, television, the development of plastic and synthetic materials, biochemistry, medicine and agriculture.

One weakness in Great Britain was the best application of scientific knowledge. To Professor Kipping, of Nottingham, for example, was due the credit for the basic work which led to the development of silicones in Russia and the U.S.A. Yet

[Continued on page 185

'Il Faut Cultiver Notre Jardin'

Sir Cyril Hinshelwood at Edinburgh

Sir Cyril Hinshelwood, M.A., D.Sc., F.R.S.

Sir Cyril Hinshelwood reviews changes in scientific thought of the past decade. Modern mathematical laws give science a cold, formal negation that seems to refute a deeper understanding. But we stand on the threshold of even more surprising changes than before—the mind-matter relationship itself. In defence of science—it may destroy men's bodies when misapplied; more human agencies destroy their souls. Modern cellular research is slowly yielding life's secrets—these will aggravate the cries against science if they are misused. Today science is threatened by bureaucratic accounting on the human side and trivial work on the scientific. Sir Cyril looks to the future.

THE impression which the historian gives to the layman, and probably also to the initiated, is that the year 1851 in Britain symbolised a blossoming of hope and faith. Material and intellectual discovery, the spate of scientific investigation, and the exuberance of the age all contributed to a sense of springtime in the achievements of this nation, and a subtle feeling that the eternal values themselves were in some way continually augmenting and widening their beneficial sway.

Reaction from the spirit of these balmy times has been sad indeed. Hopes were disappointed, hostile critics rallied, men of science themselves have sometimes felt disorientated and uncertain of their aims, and some even confess to a feeling that their scientific functions are subordinate to economic and political ends. Others have had to fall back before the complacent assertions of their detractors that science has no concern with values—as though truth were not the greatest of these.

Some of the Victorians in the enthusiasm of their conquests thought perhaps that the inmost citadels of nature would soon fall before them. Their hope was an illusion, and recovery from the pessimism and dejection that ensued from it is far from complete. Yet the defeat, as so often is, was really victory. The facile prize was lost, yet the realm of potential discovery expanded in a way transcending all that some of our predecessors in their philosophy had dreamt of.

Perhaps at this moment there may be profit in attempting to take stock of the realities of the situation, and to examine against this general background some particular themes of interest to the science of chemistry.

The great chemical events of the past century have unfolded themselves in many fields. The vast evolution of chemical theory, and our views about the basic substratum of things, the perfection of synthetic chemistry, the conception of energy and the knowledge of its subtle laws that reveals to us the intimate mechanisms of chemical reaction—all have had resounding intellectual echoes and revolutionary practical results. And now at this mid-century the chemist after a long and eventful approach stands face to face with the problem of life itself.

As a reflector of the profound changes that have occurred in scientific thought over the past few generations, the evolution of the central theory of chemistry—the atomic and molecular theory—shows us the nature of the threshold at which we now stand.

At its inception the atomic theory explained adequately the quantitative laws of chemical composition but it gave no clue to the nature of affinity. Were valency bonds material projections from the atom, and if not, what made the atoms combine? people

began to ask. The assumption of a physical excrescence on the surface of an atom denied the conception of an indivisible atomic unit, and on closer scrutiny the idea rapidly assumed a somewhat nonsensical air. This very simple example of a logical awakening typifies in its primitive way much that has followed.

With the discovery of the electrical constitution of matter, of electron patterns and electrostatic forces, the theory of valency took a more sophisticated turn, and on the afternoon of the struggle it seemed that the prize was won. But in the early light of morning the deeper difficulties of electrostatic forces and the question of why atoms should attract or repel on balance appeared still more formidable.

The Quantum Laws

These questions were solved in their turn by the quantum laws, and even from these only in their most finished and abstract form. But the tenets of these laws, with their requirements about the obscure quantity called 'electron spin'—about which little is really known save that it possesses one or other of two possible values—imply properties of electrons quite unlike those of any particles known to gross macroscopic observation. Individuality is gone, there is no longer any sense in the statement that one of two identical electrons is here and the other there; only the sense that one electron may be said to possess characters different from those of another survives.

Modern mathematical laws enable calculations of behaviour to be made, but these laws are strangely unsatisfying to the minds of many. They seem to deny the possibility of the deeper kind of understanding. They present to the inquirer that austere negation which the philosophy of logical positivism seeks to impose in a wider sphere.

Observable phenomena may, according to this grim code, be correlated but the kind of satisfaction which men of all centuries have looked for and called understanding must be renounced as a frivolous desire for something which does not exist. From this, mind and matter in philosophy at large, individual ultimate particles in physics and chemistry, so far from being immutable essences, become fictions providing illusory answers to improper questions. What a remarkable change from the excessively naïve and crudely mechanical conceptions of the early atomic theory.

But is this really to be the end, or does what is nearest to us loom at the moment in too large a perspective? Are science and philosophy really to be reduced to the filling in of forms about observables and the acceptance of the official answers?

So far from accepting this bleak doctrine, I think we may well stand on the threshold of even more surprising changes. If our present notions of particles and forces have involved us in difficulties and contradictions, then the plain inference is that we must go on thinking.

From the nature of the case I cannot foretell what the resolution of the present dilemma will be, but there is one reflection on the subject which it may be well to make. A surprising amount of the structure of chemistry is now seen to depend upon the famous Pauli principle, which may be said crudely to recognise different kinds of electron, but not different electrons.

Behind this lies some deep mystery relating the possibility of detection with the very existence of the entities postulated in physical theories.

In a glass darkly one seems to see here some connection with the mind-matter mystery. All attempts to say something helpful about the relation of these two interpenetrating but apparently immiscible worlds has so far led to contradictions, frustrations and absurdities.

The Problem

The logical positivists in their cavalier way say that there is no mind-matter problem, but clearly there is one, and thoughtful people will go on wrestling with the question. Surely there is stimulus in the discovery that in physics and chemistry the things themselves which we suppose to underlie our observation of the world seem to have properties intimately conditioned by the possibility of observation.

There certainly opens here no avenue to a facile idealist philosophy: not yet, it is permissible to feel, is the opening into a mere cul-de-sac. Perhaps rather it is the alluring entrance to a labyrinth through which a way exists for those who will be fortunate enough to find it.

The cycle of discovery, premature assumption of finality, disillusion and renewed endeavour is very characteristic of the scientific life. Easy predictions of unlimited progress are of little value, but in this strange region of which we have at least now become

conscious, the goal lies very far ahead, but seems more worth striving after than ever. If we feel at times that advance has almost stopped, it is I think because we take a foreshortened view of the road already traversed. Before we conclude too readily that the limit of knowledge is reached we might do well to bear in mind that the human power of understanding may still have something in reserve.

Such reflections, valid though they may be, are somewhat remote from practical life, but the pragmatic conclusion is that we should continue patiently on the road.

Up to here these remarks have dealt with the fundamental theoretical aspects of chemical science. Although these deep and enthralling problems lie on its boundaries, much of chemistry is of a more workaday character, and for that reason less exposed to the hot and cold winds of exaltation and despair.

But its closer relation to practical affairs lays it open to another form of attack. The gifts of science we are told, are in danger of being utilised not for the benefit but to the detriment of mankind, and voices are even heard which call for the restraint and repression of discovery.

Men of science are sometimes represented as blind to higher values, and loosing upon an innocent world agents of untold destruction. This charge seems to me as grave as it is misguided, and in the course of my subsequent observations I shall take it upon myself to answer it.

Scientific Advances

But let us first look again at the major trends of chemical advance. The atomic and molecular theory, reborn beneath the murky skies of Manchester, provided the conception that atomic patterns underlie all substance and determine all properties.

Ever varying combinations of known and new methods continue to increase the wealth of knowledge about the chemical structures of all the compounds significant in nature or art, and now the aid of the mathematician is being invoked in the understanding of the stability and other properties of these manifold chemical systems.

In the great world of synthetic chemistry the chemist has not only learnt to discern the underlying patterns but to weave them largely according to his own designs, and we are sometimes asked whether this web is woven to good or evil ends. In addition, there are dyes which surpass nature in variety and often transcend it in beauty, drugs that heal deadly sicknesses, polymers which adapt themselves in strength and flexibility to every diverse need. These and many other things follow from the chemist's knowledge of the architecture of the molecule. Even the subtlest agents of biochemical function, such as adenosine triphosphate, are being built up by his skill.

Science Not to Blame

The same virtuosity, it is true, produces explosives of increased power or poisons of greater potency. But can it seriously be laid at the door of the studious minority if the agents they produce to blast rocks are prostituted by the majority to blast one another? Though the precise calculation would be difficult, I should be prepared to venture the assertion that in the past century the good wrought by antiseptics and anaesthetics in saving lives and alleviating suffering far outweighs the evil which explosives and poison gases caused in wars. And speaking of the future it is at least a possibility that the control of cancer may emerge from the detailed chemical study of cell mechanisms.

No less important than the knowledge of structure has been the understanding of the laws of energy, and the application of physical ideas to the interpretation of the intimate mechanism of chemical reactions. The molecular and kinetic theories, the discovery and interpretation of the laws of thermodynamics have not only illuminated our view of nature, but have led to the rational understanding and control of all the varied processes on which chemical manufactures depend, and of all the applications and utilisations of energy.

Increasingly efficient machines, they are fond of telling us, are used for dropping destruction from the skies, but there is no scientific reason for this pastime. Nor have the works of man ever vied in destructive power with the vagaries of the Yellow River or the dire invasions of the great plagues.

Beneficial uses of energy, analysed in Sir Harold Hartley's masterly address of last year, far outweigh the destructive. At the most primitive level they save us from freezing, and in more subtle ways the complex special fuels which the chemist now brings forth prepare a way for a unification

of the world which is only impeded by vices of a kind having no connection whatever with science.

What is the power of destructive weapons compared with that of lying propaganda? And was this product of the devil begotten by a man of science? The intentions of applied science may attack men's bodies, those of seemingly more human agencies can destroy their souls. To wish to inhibit or restrict scientific discovery is to show an utter lack of faith in human destiny.

If there is any controversy about this, then it is not men of science who are blind to higher values, and in any case it would be preferable to be blind to higher values than to use an arrogant personal conception of them to stifle the pursuit of truth by others.

The Secrets of Chemical Change

But to return to chemistry itself, one of the great waves of advance in the past century has been the detailed understanding of what actually happens in the course of chemical changes; how molecules collide and impart energy to one another, loosen their bonds, exchange their atoms, mutually induce electrical displacements, at times shed active fragments which creat a sort of epidemic disturbance called a chain reaction, and at other times anchor themselves to surfaces where they enact their strange little dramas in a sort of Flatland of their own.

Evolutions of atoms and molecules about which chemists now have precise knowledge are far more remarkable than those conceived by the poetic imagination of Lucretius, and this knowledge guides the manufacture of plastics, of dyes, and of every conceivable kind of chemical product. It is still advancing, and the first hesitant steps are being taken which transform an inductive into a deductive science. There is very far to go, but the journey is started.

In this matter of the mechanism of chemical reactions, I should like now to refer to the great field of the chemistry of the living cell, that wonderful skeleton of reactions out of which the life process is woven.

Chemistry, if not the father of life, is at least the godparent endowing it with its material substratum. In the last analysis the properties of the cell are determined by the molecular configuration of its substance, the arrangement of amino-acid residues in proteins, the composition of the nucleotides, and the folding or piling of the chains and stacks which all these various entities form.

When a cell reproduces itself, protein chains must grow, like the polymeric molecules of the plastics industry. The nucleotide plates pile up, rather in the manner of crystal formation, but these two processes are subtly interlocked, and guide one another, as well as being in constant interplay with other reactions.

Growth of a cell involves, as it were, an elaborate symphony of chemical reactions, the rules of which are slowly and surely being discovered. The chemical basis of the cell, with its function both in health and disease is thereby being gradually discerned.

What is dimly appearing includes the mutually aided autosynthesis of protein and nucleic acid, changes in proportions of enzymatic material in response to the change reaction velocities imposed by various environments, and discontinuous modifications in the molecular pattern caused by radiations or the accidents of abnormal cell division.

The cell with the relatively stable structure of the molecular patterns which are the basis of its genes is a system of great traditional conservatism, but one which exhibits also, response to change both of a long range and of a short range character, change imposed both by chance and by environment. Over and above this, we see the mass-mixing of chemical characters when cells undergo processes of sexual union.

More Being Discovered

Relative parts played by all these different effects are slowly being disentangled. The division of the cell itself, which is a necessity for the preservation of the type, is imposed by a physico-chemical influence known as the scale effect, and occurs without any doubt in response to a physico-chemical stimulus, about which more and more is gradually being discovered.

Selective influencing of cell processes occurs in many ways, and opens the door to the great practical field of chemotherapy. Chemotherapy itself is still in its infancy, and generations may well pass before it fulfils all its promise. There is ground neither for facile optimism nor for gloom, but simply a challenge to patient resolution. Growth must be long and difficult, because as yet the rational chemical basis for much that we know is incomplete. But the first dim outlines of it are certainly there.

At any rate the application of chemistry to health and healing is not likely to arouse the criticism of the layman except perhaps on the ground that it proceeds too slowly.

There is, however, a more sinister aspect even to these things. As the cell reactions disclose their secrets, as physiology advances, and as the relation of chemical structure to effect on cell and tissue clarifies itself, there will emerge the possibility of deep-seated chemical intervention into processes which are now normally inviolate.

Chemically induced mutations of cells are already known in a crude fashion, the influence of drugs on personality already exercises medicine and law, and the day may well come when a conscious moulding of individuals and even of races will present problems of fearful fascination.

If this day does indeed dawn the sky will ring more widely than ever with cries against science, and the old battle of ultimate values will be joined more vigorously than ever. But it will still be those of little faith who fear the conscious intervention of mankind in the fashioning of its own destiny, and who oppose what could equally well be represented by those so minded as part of a great purpose.

The Distant Prospect

As we pause to gain a second breath at this mid-century we are assailed by complex emotions. The distant prospect thrills, the clouds of pessimism are transient, the flames of opposition die down like Wotan's magic fire before those who are not afraid. But the scale of effort and endurance demanded seems to exceed the conceptions of the past. What then must we do?

There are two aspects of this question, the scientific and the human.

Practically, an immensely important task of the man of science in general and of the chemist in particular is to protect himself against two very present menaces, the one of being controlled by obscurantist critics, the other, much more dangerous, of being smothered and frustrated by those who may think they wish him well.

The Scientist's Sargasso

The man of science is in peril of being swept away into a Sargasso of administrative seaweed. He is constrained to forsake the laboratory for the conference hall and board room.

Endless trivial reportings are displacing learned writing, petty shifts consume creative energy, and the whims of bureaucracy and doctrinaire accountancy more and more usurp the place of liberal management. This has already gone so far that a temporary decline in fertility in the near future is almost inevitable, but with resolution and skill we shall come through.

On the scientific side there has grown up a thicket of specialised detail with a loss of wider perspectives. This, too, is temporary and will pass as broader syntheses are constructed, and as new and more powerful theories succeed further in the tasks of co-ordination and prediction.

If in face of all these hopes and fears, doubts and assurances, we ask for a policy, there is no principle more pertinent, more sane or more necessary than that of Voltaire's hero, Candide: '*Il faut cultiver notre jardin*'. If the chemist follows this homely advice and unconcernedly cultivates his own, it will not fail to go on producing its flowers and fruits in undiminished profusion.

THE ADVANCE OF SCIENCE

Continued from page 180

until this year, this country had been dependent on imports from America of marketable silicone products.

A matter for grave concern is the lack of a co-ordinated system of scientific and technological education in this country. Excellent as they are, the existing institutions, which have grown up to meet particular circumstances, do not produce anything like enough trained technologists to meet the urgent needs of scientific development in industry and to provide leaders for the future. It is to be hoped that the new and rather uncertain science of education will develop fast enough to solve this.

Shortage in Britain of 'personnel trained and eager to apply scientific knowledge and scientific methods to practical ends'—as Sir Ewart Smith said last year—is only one of the many shortages which the world is now facing. Among them are food, non-ferrous metals, steel alloy metals and sulphur. These very shortages are due to the scientific complexity of present-day life and it is only by science that they can be overcome.

The Changing Face of Chemical Industry

Influence of the Chemical Engineer

THE growing importance of the chemical engineer and his influence on the development of the chemical industry were traced by Mr. W. H. Cremer, C.B.E., president of the Royal Institute of Chemistry, in the discussion held yesterday (10 August) by the chemistry section of the British Association now meeting in Edinburgh.

After tracing briefly the effects produced by the rapid growth of the chemical industry in the 19th century, Mr. Cremer cited a number of factors which had contributed to a different outlook and better conditions.

Foreign Competition

First, increasing competition from industrially-minded countries abroad had necessitated greater process efficiency and consequently less waste of materials to the atmosphere or to streams and rivers.

Secondly the extension of the industry to include a much wider range of products such as textiles, foods, pharmaceutical preparations and so on, which of their very nature required entirely different manufacturing techniques from those formerly employed in the heavy chemicals. Agricultural requirements both as regards fertilisers and insecticides formed an important part of the chemical industry today, while the prospects opened up by the utilisation of synthetic plastics appeared to be almost limitless.

At the same time a significant change of outlook had occurred in the approach to modern chemical industrial problems. There was a unification of approach, mathematicians, physicists, chemists, biologists, geologists and metallurgists, all tending to work together, as required, in teams, rather than as somewhat isolated individuals.

As regards the appliances employed in this extremely varied and far-reaching industry, scientific discovery, if it was to be applied usefully, made more and more exacting demands upon the designer and fabricator of chemical equipment.

Many present-day processes operated upon an immense scale requiring pressures undreamed of on an industrial scale even a few decades ago, and sometimes these high pressures had to be combined with comparatively high temperatures. Not only had the chemical engineer made many contributions in this field in extending knowledge of the principles on which plant design was based, but his work would be largely unavailing had not the metallurgist produced the special constructional materials needed to implement these designs.

One outstanding contribution which the chemical engineer had made was to view in selected categories, instead of piecemeal, the process operations used in the very extensive range of industries with which he was concerned. He had recognised that the physical principles underlying these operations were the same, however different in form the appropriate appliance might be for a particular product. This apparently obvious concept had quite revolutionised the teaching and procession of chemical engineering, and chemical industry had greatly benefited.

Today the chemical engineer recognised a number of 'Unit Operations,' such as size reduction, size separation, evaporation, drying, distillation, filtration and so on. The principles underlying them were common to *all* industries, although the actual method of applying these principles might differ with the properties of the individual product to be manufactured. Mankind could not reap the benefit of the genius of the research chemist unless the chemical engineer was able to translate the work of the laboratory to the factory scale, and in this respect immense strides had been made.

Welfare of the Workers

Finally the author referred to the safety and welfare of the workers employed in this vast industry, and to some of the hazards which they encountered. The study of occupational diseases had advanced greatly in recent years, and this factor, together with the others, had clearly created, in his opinion, an industry, somewhat haphazard and irresponsible at its outset, but which was now integrated and much more conscious of its obligations to the public which it directly or indirectly affected. Mr. Cremer said he believed that the time had arrived when there was a much better prospect of science being properly wedded to industry and in turn industry to civilisation.

Shortage of Scientific Man-power

Importance of Further Education in Technology

PARTICULARLY heavy demands for chemists, physicists and engineers will arise with the implementation of the re-armament programme and this will aggravate the problem of the shortage of scientific man-power in Great Britain.

This lack of properly trained men for certain specialised fields and the problems of higher technological education are the main points emphasised in a White Paper on 31 July (HMSO, 9d.).

During the period covered by the report (April 1950 to March 1951) the council's terms of reference 'To advise the Lord President of the Council in the exercise of his responsibility for the formulation and execution of Government scientific policy,' remained unchanged.

In its last report the council observed that, with the post-war expansion of the universities that had taken place as a result of the recommendations of the Barlow Committee, enough scientists were now being trained to satisfy the short-term demand, but that temporary maladjustments might continue to occur. In the long-term, it was considered that the level of output of scientific graduates that had resulted from the implementation of the policy advised by that committee should be maintained.

Scientists as Executives

If British industry was to improve or even maintain its present position in the world, it would have to employ more scientists both in the conduct of pure research, and still more, in its application. In order to improve the scientific approach and understanding of industry a more general adoption was advocated of the practice abroad of employing in leading executive positions highly qualified scientists with administrative ability and, in addition, of employing those of lesser calibre in technical positions which, in this country, have not so far been regarded as worthy of professional qualifications.

While it was obviously impossible to increase further the output of scientists by universities in the short-term, the turn of events showed that, if anything, the council in its report of the previous year, had underestimated the difficulty. It was apparent that the demand for scientists over a wide field would be greater than the available supply.

It was now widely accepted that if this country was to retain its place as a leading industrial nation, a far greater number of technologists would have to be employed in a variety of capacities, including posts of the highest responsibility in industry. Many public statements had been made during the past year about the importance of further education in technology. Unfortunately the real nature and scale of the problem were not always fully appreciated, and there was still room for further clarification.

Distinct Types

Although it was convenient to talk of technologists as a group, they were in fact of many types and grades. The aspects of technology appropriate to universities and technical colleges were not the same though they might overlap to some extent. Both universities and technical colleges had a distinct contribution to make to the solution of the problem.

Facilities for technological training in universities had been expanded in the last five years as rapidly as difficult circumstances permitted, and at a limited number of universities arrangements had been made for more extended courses than had hitherto been available. There were now about 11,000 students in the applied science departments of universities as compared with somewhat less than half that number before the war.

Recently, also, emphasis had been put on methods of raising the status and prestige of non-university awards in technical colleges. The need for the provision of better buildings and equipment and the improvement of staff pay and conditions had also been widely discussed.

It was important to bear in mind that the necessary development of technological education was a very long-term process which, from its nature, must take more than a decade to bring about. Some apparent conflicts of view were due to confusion between proposals for the next three to

five years and those relating to a decade or more ahead.

The report of the National Advisory Council on Education for Industry and Commerce, issued in October, 1950, recommended the establishment of a Royal College of Technologists, which would be responsible for approving courses in technology and for bestowing an award, as well as for the promotion and encouragement of technological education.

The report met with a mixed reception, but the Advisory Council on Scientific Policy supported the idea that it should make an award distinct from university degrees and other scientific and technical qualifications and felt that the proposed college would exert a favourable influence in raising the prestige of technological education and in securing a wider recognition of its importance.

Expansion Essential

At the same time, this proposal did not meet the need for an expansion of the facilities for higher technological education, and the council reiterated the view that expansion of these facilities was essential if this country was to develop a balanced supply of applied scientists of adequate calibre and training to achieve the broader and more vigorous applications of scientific methods and advances upon which its industrial prosperity so closely depends.

Referring to the under-developed areas of the world the report stated that if all the plans which have been discussed came to fruition the demands likely to be made upon our resources of scientific man-power would be impossible to meet without serious damage to other commitments.

While it appreciated that the facilities for training in this country were already severely taxed, and that the financial provision might be curtailed, the council advocated the importance of finding places for people sent to this country under the Colombo Plan.

Discussions on the Colombo Plan had shown the value of initiating pilot schemes in the first instance rather than undertaking full-scale work on projects which might not, because of unforeseen difficulties, produce results commensurate with the expenditure in skill and resources.

A Scientific Library and Technical Information Committee had been set up to co-ordinate the development of scientific libraries as a whole and to consider in greater detail the parts played by individual libraries.

A report had been received from the committee relating to the needs of the national library of science and invention which would form part of the new Science Centre. The long-term proposals for a Science Centre, originated by the Royal Society were approved in principle by the Government in November, 1950.

The council understood that the President of the Board of Trade had agreed that the Patent Office Library should be expanded to form the national reference library of science and invention, and that it would continue to serve the needs of the Patent Office. The library would cover the whole field of science and would be supported by the specialised libraries of the learned societies. The areas of its responsibility had been agreed with the Research Councils and with the Government Departments principally concerned. A novel feature of the library was that it was not proposed that it should contain any scientific literature over 50 years old.

In conformity with this plan, material which had ceased to have value for current work would be pruned in consultation with the British Museum. The library would serve working scientists in industry and all those concerned with research and technical development, but it would not provide for other users such as undergraduate students, for whom other facilities existed. The library would be adjacent to DSIR and although it would provide an information service, users would where necessary be referred to the more detailed information service maintained by DSIR.

Micro-Films Valuable

In preparing its report, the committee had regard to the rôle of micro-films and other photo-copying devices in the modern library and also to measures for securing a prompt binding service for the library's books.

The council described as inadequate the existing machinery for testing the possible harmful effects of toxic substances used in consumer products such as manufactured foods.

New legislation need not be introduced at present, it suggested, but the problem should be brought to the attention of manufacturers, who should be informed that they were expected to take all reasonable care in offering new substances for sale.

Corrosion Prevention

Changing Techniques in Synthetic Resins

THE specialised materials demanded of the industrial chemist by engineers engaged upon anti-corrosion work fall principally into the following categories:—

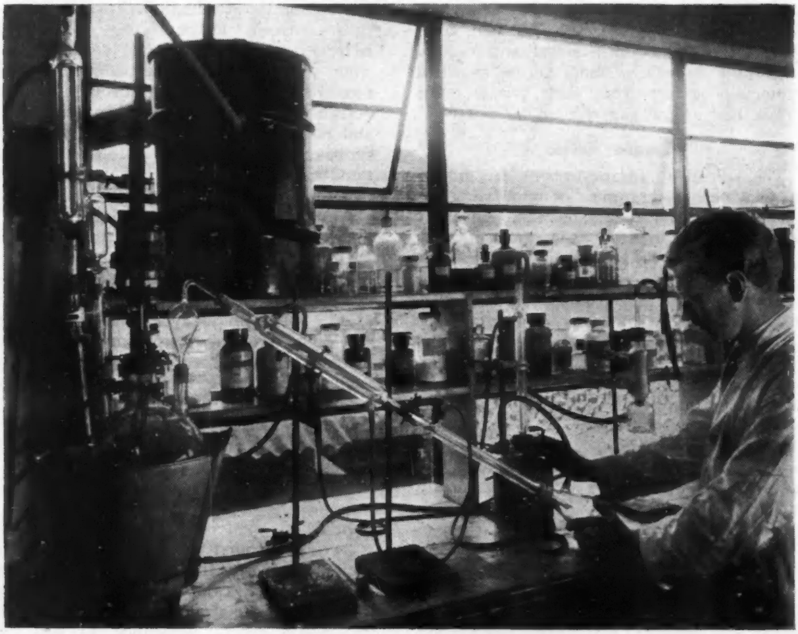
(i) Bonding agents for constructing protective brick linings in tanks and other liquid containers.

(ii) Cements for corrosion-resisting floor construction.

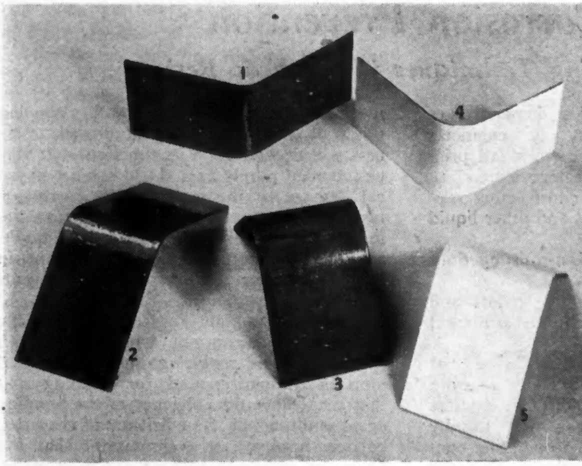
(iii) Surface coatings (films, paints and compositions) for the protection of structural metalwork and concrete.

The design and constructional detail of tanks and other structures intended to store or to convey corrosive liquids are matters which the chemical engineer will usually decide in the light of specific operating conditions. Very often, however, either the structure itself, or an inner corrosion-resisting lining or membrane, will be protected by means of an internal brick wall. Whether this wall is of half-brick or full-brick thickness will depend upon its functions. It may be intended purely as a shield against physical damage to the tank and its corrosion-resisting membrane or it may be required, in addition, to absorb heat from hot liquids, and thereby effect a desirable reduction in the temperature of the corrosive agents reaching the membrane.

In protective linings of this nature the brickwork is of normal construction with special cements replacing the cement/sand mortars ordinarily used for bedding and jointing. Since the efficiency of the bonding agent is ultimately the efficiency of the brick barrier, however, it is important that the choice of cement should be carefully made. As in other fields, laboratory-developed resins are becoming increasingly popular for



Typical apparatus for the production of furane resins on a laboratory scale



Brittleness of standard paints is shown here by examples 1, 2, & 3, while the flexibility of paints based on epichlorhydrin resins is clearly seen in examples 4 & 5

this purpose. Because of their superior chemical characteristics cements based on these synthetics are slowly but surely displacing older cements, such as that compounded from sodium silicate and sodium silico-fluoride which, while giving excellent protection against strong acids, is susceptible to alkaline attack and erosion by water.

Furane Resins

The so-called 'furane' resins are among those which give promise of good performance. Cements based on this group of resins are resistant to a wide range of acids and to almost all alkalis and they are completely impervious to greases, oils and fats.

Resins can be produced from the furanes in several different ways. Phenol, for example, can be made to react with furfuraldehyde in much the same way as it can be made to react with formaldehyde and an entirely new range of resins will result. But although phenolic resins have been used in chemical-resistant work, the furfuryl/phenolic types are inferior to those obtained from furfuryl alcohol. When treated with acid, furfuryl alcohol resinifies rapidly and, indeed, explosively.

This violence of the normal reaction makes processing difficult and various patents have been published covering methods of obtaining a partially condensed resin syrup which will condense further with continued acidic treatment to yield a hard, insoluble and infusible substance. In the process generally followed a stabilising agent is employed and the reaction takes place at a carefully controlled temperature. The alcohol is heated in the presence of a catalyst and when the chemical change commences, the mixture is quickly and thoroughly cooled before exothermic reaction causes boiling and explosion. As required, the resulting syrup can then be further set off by the addition of small amounts of mineral acids (which can, for convenience, be absorbed on charcoal) or of other chemicals such as *para*-toluene sulphonic acids.

Other means of producing the intermediate syrup are in use. It has been claimed, for example, that by using a proportion of formaldehyde with the alcohol, a syrup is obtained having superior qualities of resistance to certain corrosive agents. Again, others prefer to condense the furfuryl alcohol, or even the furfuraldehyde, with ketones (the higher ketones being preferred) and by this means also a syrup having cold-setting properties is obtained.

Food Processing Plants

In the field of corrosion-prevention these syrups have found their principal use as the basis of cements for bonding and bedding brickwork and in the main the cements have found particular application in food processing plants where resistance to oils and greases is of equal importance to the

withstanding of corrosive attack of fruit juice acids. The cements are hard and tough, however; they bond reasonably well to brickwork and it is certain that because, in alliance with good engineering bricks, they provide efficient protective linings, they will become increasingly popular with the corrosion engineer.

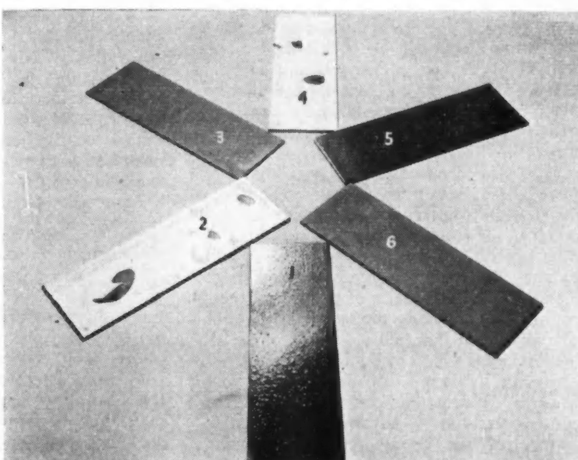
Furane cements are packed in their constituent form, *i.e.*, as a filler and a binder, the latter being the resinous syrup. Incorporated in the filler is an accelerator and when the ingredients are brought together the cement at once begins to set and the mixture must therefore be used within 30-60 minutes. Once hard, the cement is practically insoluble in any commonly used material.

The resins which are being so thoroughly investigated as bonding media for protective brickwork construction, naturally lend themselves readily to corrosion-resistant flooring work. The conditions of chemical attack are closely related and the factors distinguishing the two forms of work are chiefly of an operational nature, *e.g.*, traffic conditions. Cements used for the building of protective linings to tanks and vessels, therefore, are equally available for consideration when determining the type of floor necessary to withstand specific operating conditions. Synthetic resins are being used as the basis of jointless composition surfacings where neither the degree of chemical attack nor the nature of the traffic exceeds a moderate severity, as well as for the bedding of the quarry tiles and acid-resisting bricks used in heavier floor construction.

In the protection of structures, where the corrosive agents take the form of gases and vapours, compositions of a paint-like nature are most frequently employed. Ordinary paints are rarely satisfactory but during the last few years much work has been put into the development of formulæ permitting the adaptation of suitable resins to conventional paint technology. The resulting 'paints' vary from the simplest solutions of resins in appropriate solvents (sometimes all that is necessary to provide a corrosion-proof film) to complicated chemical compositions.

Undiluted Application

The weakness of many such paint formulations is that by far the greater part of the composition is solvent which acts only as a carrier for the resin. This solvent is, of course, lost to the atmosphere when the 'paint' is applied and therefore contributes nothing to the ultimate efficiency of the composition as an anti-corrosion coating. With vinylite resin paints, for example, which are among the best of this type of composition, depositing a film giving good results (providing the attacking agents are not hot), the solid resinous content of the solution is of the order of 10 per cent. Hence the importance of research into resins capable of being



Damp surfaces present a serious problem in the successful application of conventional anti-corrosive paints (examples 1, 2, 3, 4 & 5). 'Wash primer' paints, however, applied under the same conditions show no evidence of blistering (examples 3 & 6)

applied undiluted or in much more concentrated form.

Several attempts have been made to use cements based on furane resin syrups in the form of rendering coats to metal and concrete surfaces. These attempts have not been successful owing to the brittle nature of the cement and to its lack of strong adhesive properties but modifications to the the basic formulæ have proved possible which permit the cement to be made up in a form resembling paint or paste. This can be applied by brush or trowel to give excellent resistance to many chemicals and corrosive liquids. Furane resin syrups used in this way are substantially solvent-free and when the composition is applied to the structure every ingredient forms part of the corrosion-resisting barrier.

Epoxy Resins

An even newer group of synthetics likely to evoke interest by reason of their superior resistance to many corrosive agents are the epoxy resins. These are derived from epichlorhydin and they combine the three most important characteristics of a surface-coating resin, *viz.*, good adhesion to the base, flexibility and chemical resistance.

Although, again, there are various ways of formulating coating compositions from epoxy resins, for example in combination with alkyd resins, the direct application of the resin formed from the base materials is to be preferred for maximum protective power. In the form of a solution the resins can be painted over metals without the need of a priming coat, an excellent bond being obtained both to steel and non-ferrous metals. The air-drying film may either be stoved, to increase resistance to certain corrosives, or allowed to harden at room temperature. These new resins are expensive and price considerations will probably govern the speed of their development for such desirable but costly operations as the coating of structural metalwork in industrial plants generating highly corrosive gases and vapours. But they do represent a distinct advance upon older types of resins and their development indicates the effort being put into research in this field.

Resins prepared from liquids derived from cashew-nut shells are also finding their way into surface coating compositions in the fight against corrosion. As in the molecular structure of the epoxy resins, the cyclic sections of the molecule are separated from each other by long chains—in this case containing unsaturated linkages. It is this structure which leads to the development of flexibility in the resins during the process of resinification. Resins prepared from cashew syrups have already been compounded with suitable hardening agents for use as cements in acid-resisting brickwork and anti-corrosion floor construction. It is logical to expect that attempts to take advantage of their acid-resisting properties will lead to the continued development of these resins as the basis of surface coatings. Except for nitric acid (up to cold only) 10-20 per cent cashew shell resins will withstand acid up to concentrations of 50 per cent and they will withstand all alkaline attack. They are not so resistant to oils and greases, however, as the more recently developed furane resins.

Another new class of resins worthy of special mention is that known as the styrenated alkyds. Here the styrene molecule is combined with an alkyd resin to give a compound which, whilst capable of being treated as a conventional alkyd resin for purposes of preparing formulae, has an increased resistance to chemical attack by reason of the styrene 'reinforcement.'

Undoubtedly styrenated alkyd resin formulations will find a useful place in the corrosion engineer's armoury. One important factor will have to be borne in mind, however. The degree of prevention of corrosion is not always dependent upon the degree of impermeability of the paint film. Corrosion is, very largely, an electro-chemical phenomenon and one excellent way of providing protection is to use as a coating a composition rich in zinc. In the case of the styrenated alkyds, however, the film possesses such good electrical resistance that the dissipation of the electrical currents set up in corrosive activity is not easy, even although the film may be loaded with zinc dust.

Passivating Effect

Without doubt a great step forward has been achieved in the development of the so-called 'wash primers,' the resins used as the base of which are of the polyvinyl butyral type. In these primers the resin is admixed with zinc chromate pigments and free phosphoric acid. The acid content has a marked passivating effect on the steelwork to which the coating is applied. Finishing coatings may thus be applied without risk of the chemical reaction which may take place beneath them.

The Defence of Profits and Dividends

Sir Ernest Benn on the Need for a Fighting Spirit

THE Chancellor and his colleagues are committed to the theory that production should be 'for use and not for profit' and indeed the literature of Socialism accepts as axiomatic the Ruskinian dictum that sin and profit are synonymous.

Remembering that, in considering Mr. Gaitskell's latest threats our attitude should be one of thankfulness for the merciful restraint of an all powerful Chancellor who, perhaps from a weakening of his own faith, has thought it wise to take something rather less than the whole of the dividends of industry. His present extortions must be regarded as just another step towards his Utopian goal; and, in view of his lack of concern for the losses of every nationalised undertaking, he is unlikely to worry at the prospect of putting private shareholders in the same position as the nation and thus clearing the ground for his new and better world.

In these very simple circumstances, explained *ad nauseam* from the days of Marx and Ruskin, it is almost paltry to discuss the anomalies, inequalities and injustices of the present plan to limit dividends. Such argument, in its weakness, boils down to this: 'You are taking rather more from me than from somebody else and that is not fair'; to which complaint the complete answer is to take a little more from the somebody else.

Too Much Compromise

What is wanted is a fighting attitude on the part of those who know that profit is the life blood of industry and commerce. Lord Lyle of Westbourne, with his 'Mr. Cube,' has given a lead in this vital matter which must be followed by all who recognise their responsibilities to society. The spirit of compromise and accommodation has gone far beyond the bounds of reason and become a positive danger.

Far too many employers are at pains to apologise for profit; elaborate explanations and calculations are put before the workers, and the public, to explain how very small and harmless are the net receipts of shareholders and proprietors—a line of argument such as was used by the lady who pleaded, in mitigation of her offence, that the illegitimate baby was only a very small one.

The attack should be taken right into the field of the enemy. The profit system can offer a security for wages and employment such as is outside the power of any political arrangement. It is the only scientific way of securing economy, a point well worth stressing in view of the Chancellor's proposal to go back to all the stupidities of 'cost-plus,' a Lloyd-Georgian sop to labour which added a third to the cost of the 1914-18 war. If to all the pressures already promoting inflation 'cost-plus' is now to be added, then the flight from the £ will be given the last fatal impetus.

Profit and the Worker

For the wage earner the case is simplicity itself, if only employers would stand for the faith of which they are the trustees and guardians. The workers can never secure what they so rightly desire, except through the medium of profitable trade and industry. The idea that wages and profits are antagonistic finds no support in any of the facts of the case; wages (money wages) can be secured by forcing up prices, but seldom, if ever, by the reduction of profits.

The economic system through which civilisation has been developed is essentially a democratic system. It evolved a practical universal suffrage, in theory at least, long before any politician thought of universal votes. Under it the command is vested in every individual. The profit system makes for responsibility in the individual; any other system reduces the individual to a state in which no sense of responsibility is required or expected. Nobody, for instance, is responsible for anything in a bureaucratic system. No bureaucrat suffers any personal loss if things go wrong or if the public fail to take advantage of his services.

Under the spur of profit and the threat of loss millions of men and women do accept a very real and personal responsibility for the maintenance of economy, expedition and efficiency, out of which an ever higher standard for all is provided. Without profit the quality and genius of all these people is put out of use, no others are

invited to cultivate any sort of personal responsibility and the general standard of life is of necessity lowered.

Abolition of profit will bring about a universal state of loss. In the process, it will first of all abolish all economy, efficiency and expedition, as is now plainly shown in the nationalised industries; it will place the consumer in slavery; it will stop up the source of new capital and dispel all hope of progress. The very best that can happen if the anti-profit line is pursued is that we shall go on sharing the profits of the past until, they being exhausted, there is nothing more to share.

The old trouble between the haves and have-nots will then disappear, in the simplest of all possible ways, by turning us all into have-nots, with consequences that could only be understood by those who lived in the dark ages following the political destruction of many previous civilisations.

FBI Attack Government

New Capital the Lifeblood of Enterprise

OPEN hostility of industry to the Government is shown by the statement issued on 2 August by the Federation of British Industries which exposes the policy of restricting dividends and controlling prices as 'negative, irresponsible and harmful to the country's long-term interests.'

In view of the serious economic situation the FBI considers that the proposals of the Government are little more than an attempt to conceal inflation and will therefore only operate to conceal the disease. An utter disregard is shown for the necessity of maintaining a free flow of capital into industry, the encouragement of efficiency in production and commerce, and the preservation of an international financial market in this country.

Total output of goods and services is insufficient to maintain the present level of consumption, including capital outlay. There can be no remedy for this in the long term except higher productivity or reduced consumption. Yet this—the crux of the problem—received scant attention from the Government which produced no policy to try and achieve these ends.

Higher productivity, the federation points out, depends on incentives and flexibility. It will not be secured by exhortation accompanied by the removal of almost every incentive other than the desire to survive, or by attempting to place the economy in a straight jacket of restrictions. Effort, ingenuity and courage in production and development must be stimulated and not frustrated.

Industry is already seriously perturbed about the ability to provide capital to maintain operations because of the heavy burden of current taxation: the introduction of legislation which will inevitably create difficulties in the raising of new capital will make this situation more grave. Such legislation may well drive British capital to seek outlets overseas and militate against the investment of foreign capital in this country.

Profit is a small element in price, but nevertheless it is an essential factor in providing funds for the maintenance and expansion of industry. After payment of tax and provision of reserves the proportion distributed as a reward to the owner of the capital, who has risked it in the venture, is very small. Yet this distribution (the dividend) is vital, not only as a reward for the risk taken, but also to maintain the flow of new capital, which is the lifeblood of enterprise.

Dividends have increased less than almost any other form of income. Now, the very people who had voluntarily exercised restraint, are being penalised.

The central responsibility of the Government, the statement maintains, is to establish a sound national economy. Economy cannot be sound, nor can employment and living standards be maintained if conditions are created in which enterprise is stifled and the level and efficiency of industrial and commercial activity fall.

Only by a reduction in Government expenditure and a restoration of material incentives—the opportunity to earn and retain some reasonable reward for greater effort, for greater skill or for risks successfully undertaken—is there any hope of ultimately restoring a situation which, under present policy, is drifting out of control.

Flameproof Orlon

Development of a specially treated orlon fabric that will not burn at 1,400°F., has recently been announced by the Dupont Company, in Wilmington, Delaware. The new orlon cloth has not been flame-proofed by conventional methods, but has been processed to convert it into a product quite different from the original orlon fabric.

Oxygen Recorder

Analysis on Magnetic-Wind Principle

DEVELOPMENT of a new paramagnetic continuous oxygen recorder for use in industrial processes has recently been announced.

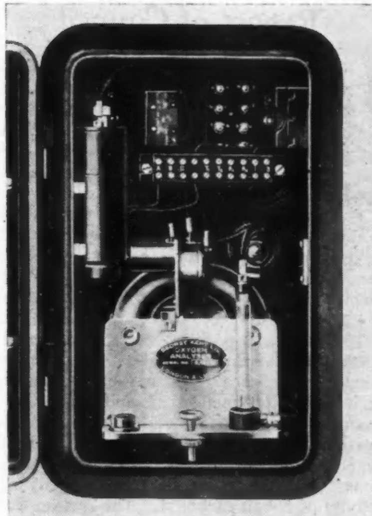
The design of the primary element of the recorder (the analyser) is based on the so-called 'magnetic wind' principle, owing its efficacy to the fact that, of the common gases, only oxygen and nitric oxide are attracted by a magnetic field, oxygen more than twice as strongly as nitric oxide. George Kent, Ltd., after five years' intensive research has produced this new instrument which is claimed to be in complete contrast to the expensive and complicated equipment in common use until recently.

It is expected that many industries which have in the past relied on inferential oxygen analysis (depending on the estimation of the content of other gases) will now adopt direct analysis with the new recorder, which besides meeting all the usual demands, will, it is suggested, find many new applications.

A generous sample of 15 litres per hour is passed through the analyser, which begins to register a change of oxygen content within five seconds of its occurrence and gives a 95 per cent response in 45 seconds.

An analyser of this type is sensitive to ambient temperature conditions, which are automatically compensated for by means of a resistance thermometer in a circuit capable of dealing with the range 0°-50°C. The temperature of the gas sample must not exceed 75°C. at the analyser inlet.

The whole instrument is capable of dealing with most of the gas mixtures met with in industrial practice, but to avoid conges-



The George Kent paramagnetic continuous oxygen recorder for industrial use

tion of orders in the early stages applications are initially being limited to the following ranges:—0-5, 0-10, 0-15 per cent oxygen in nitrogen; 0-2 per cent oxygen in hydrogen; and 0-2 per cent oxygen in coal gas.

Entirely mains-operated, the installation is supplied with a constant-voltage transformer with equipment to smooth out supply voltage fluctuations. The primary element (the analyser) can be located at any distance up to 400 yards from the recorder.

The World's Largest Glass Pipeline

AFTER more than 18 months' research and development, Quickfit & Quartz, Ltd., have put into production a glass pipeline 18-in. in diameter. This is claimed to be the world's largest in quantity production.

The pipeline, made in sections, is especially suitable for production of drugs and fine chemicals, and will substantially increase the scope of glass chemical plant in these industries.

Mr. Brian H. Turpin, the company's technical and sales director, said: 'The difficulty of producing a glass pipe of so large a diameter was initially in the production of the pressed pipe flange, and later in joining the very thick pressing to the main body. Application of glass to chemical plant has now been developed to such an extent that pipelines of this considerable diameter can now be safely handled'.

The new 18-in. pipeline is particularly suitable for hydrochloric acid absorption towers. Such a tower on a smaller scale is on show in the Dome of Discovery.

Report of Council

Italian Chemical Research

THE industrial chemical branch of the Italian National Research Council is directed by Professor M. G. Levi (Milan Polytechnic) whose report for the year 1950 has recently been published. A summary appears in the June, 1951, issue of *Chimica e Industria,* which reveals that the branch is divided into three sections, the respective fields of activity of which (broadly speaking) are organic syntheses in general, fundamental properties of compounds, and hydrocarbon chemistry.

The first section, directed by Professor G. Natta, was largely engaged in the development of syntheses using carbon monoxide, such as the production of acids and esters from carbon monoxide and alcohols. Investigations were made of the catalytic activity of cobalt in olefin-carbon-monoxide reactions, as well as of the dehydrogenating activity of cobalt carbonyl. The section was also engaged in the study of polymerisation reactions of olefins and vinyl compounds, of the kinetics of catalytic chain reactions, and of the synthesis of the piperidine alcohols.

Studies undertaken by the second section (under the control of Professor A. Quilico) related to the constitution and properties of substances recovered from a series of micro-organisms and to the synthesis of some pyridine and piperidine carboxylic acids. In the structural inorganic field the section continued its work on boranes, deuteroborones and complex compounds of beryllium. Quantum-mechanical studies were made of the activation energies of some simple reactions and of the bond energies of molybdenum sulphide. Finally, numerous studies were made of the anti-tubercular activity of derivatives related to *p*-aminosalicylic acid and *p*-aminosalicylic aldehyde.

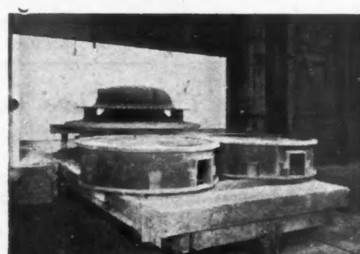
Researches undertaken by the third section (under Professor C. Padovani) concerned the catalytic desulphurisation of Middle East crude oils with the aid of bauxite, the identification of the higher hydrocarbons present in Po Valley natural gas, the production of carbon monoxide and hydrogen from methane by a fluidised catalytic process, the separation of hydrocarbon fractions by azeotropic distillation with acetonitrile, and the application of urea complexes to the identification and separation of components of light fractions of petroleum.

Jute Sacks as Fire Hazard

SPONTANEOUS combustion is often alleged to be the cause of fires in stored products. Now the Fire Research Organisation has shown that the jute sacks in which materials are stored may themselves be a fire hazard. The small hairs of the jute sacks enable flames to spread rapidly without leaving any trace of scorching, and fires started by, say, a cigarette end may be wrongly attributed to spontaneous heating.

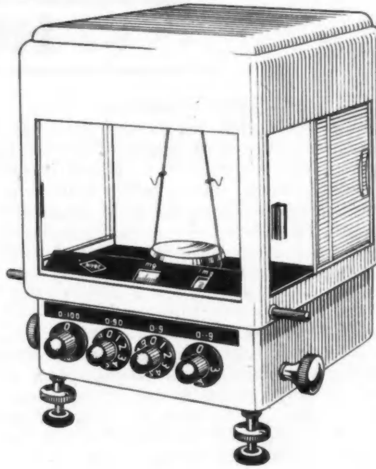
Fires which have been caused, at first sight, by spontaneous ignition have been studied in co-operation with the Home Office and the Fire Brigades. A number of them occurring in materials stored in jute bags appeared to have started at one or several points inside the stack. Many of these fires, however, bore a strong resemblance to other fires in stacks which were known to have been started from outside. In these fires the flames spread rapidly for a few moments *via* the bag hairs, over the stack and through the spaces between the bags. When the flame met frayed fabric inside, a smouldering fire was sometimes started, without anyone realising it.

The path the flame took was almost invisible. Only the fine projecting hairs were burnt and the fabric of the bag was not even scorched. Because of this it is possible that, for example, a smouldering cigarette end can cause a flame to run into the stack and start a fire inside which may be seen only hours later. The fire would later be put down to spontaneous combustion. The study of this type of fire is still going on.



Castings on a special bogie entering the large capacity heat treatment furnace recently installed by the Widnes Foundry & Engineering Co., Ltd. for annealing and stress relieving

New Aperiodic Balance



A PROTOTYPE of the Nivoc Pan Automatic Aperiodic Balance was demonstrated at the British Industries Exhibition at Olympia London recently where its appearance aroused considerable interest on George & Becker's stand. In operation the Single-Pan Balance is identical with the well-known automatic aperiodic balance developed by George & Becker during the past year or so, in which the weights are selected from a rotating table by control knobs beneath the baseboard. In the prototype of the single-pan version the control knobs are brought out on to the front of the case immediately beneath the viewing screen. A specification of the new balance is as follows:—

Beam.—5.5 in. hard rolled brass.

Weight Change.—Four control dials situated on the front of the case.

Rider Weights.—Two non-magnetic nichrome ring-type weights, 300 and 600 mg.

Knife-Edges and Planes.—Selected agate. Length of centre knife-edge, 0.75 in. Length of end knife-edge, 0.5 in.

Pan and Frame.—Chromium-plated brass concave pan 3.25 in. diameter, maximum width of frame 4 in.

Release.—Left and right-hand side action. Beam swings to zero on release.

Illumination.—12 volt, 24 watt lamp, fully adjustable.

Case.—White enamel on mahogany, with side access doors. Heavy glass base plate fitted with spirit level and levelling screws with lock-nuts. All metal parts finished in lacquered black, nickel plating, or chromium plating.

Nominal Capacity.—200 grammes.

Sensitivity.—0.1 milligramme.

Delivery and Installation.—Free in England, Scotland and Wales.

Tungsten Arrangements

ON 30 July the Ministry of Materials became the sole importer of tungsten ores and concentrates, and import licences for private import of tungsten ores will not now normally be issued, though imports will continue to be allowed under licences already issued.

The import and distribution of tungsten ore will be conducted through agents drawn from the trade. It is proposed to form a company whose management will include representatives of the following firms:—

Derby & Co., Ltd., 62/63 Cheapside, London, E.C.2; Metal Traders, Ltd., 7 Gracechurch Street, London, E.C.3; H. A. Watson & Co., Ltd., 115 Old Broad Street, London, E.C.2, and 448 Derby House, Exchange Buildings, Liverpool, 2.

Pending the formation of the company, offers of tungsten ore may be made to any of these firms, who will make bids on behalf of the Ministry. For material procured abroad by other United Kingdom merchants the bid will take account of their expenses.

Consumers of tungsten ore will be approached individually about their requirements, but, until the new arrangements can be brought fully into effect, consumers with urgent requirements should communicate with the Ministry of Materials, Branch 4.c (2). Telephone: TRAfalgar 8888, Ext. 7561.

The price of concentrates of standard 65 per cent grade and ordinary quality will be 535s. per long ton unit delivered consumer. The price will be reviewed at the end of the quarter.

· HOME ·

KID Exemptions

The following chemicals have been exempted from Key Industry Duty for the period 4-19 August, 1951:—Benzyl cyanide; *o*-cresol; diethyl malonate (an ethyl ester); fumaric acid; phenothiazine; terephthalic acid. The Order is the Safeguarding of Industries (Exemption) (No. 8) Order, 1951, published as Statutory Instruments 1951 No. 1369.

Opening of Fawley Refinery

The Esso Petroleum Company's new oil refinery at Fawley near Southampton, will be officially opened by the Prime Minister on Friday, 14 September. The refinery, which incorporates the latest type of catalytic cracking unit, when in full operation will be the largest in Europe and will contribute about 25 per cent of the refining output of Great Britain.

Corrosion of Buried Metals

A symposium on the 'Corrosion of Buried Metals', organised by the Iron and Steel Institute in conjunction with the British Iron and Steel Research Association and the Corrosion Group of the Society of Chemical Industry will be held in London on Wednesday, 12 December. Sir Charles Goodeve, director of the BISRA, will be in the chair. To gain some idea of the numbers expected to attend, applications are requested to be returned to the secretary of the institute by 13 October.

Steel Works Not to Close

Fears concerning the closing down of the Barrow-in-Furness steel works of the Ministry of Supply have been temporarily allayed. The ownership of the works is to be taken over by the Iron and Steel Corporation of Great Britain for whom it will continue to be managed by the United Steel Co., Ltd., a publicly owned company. The Hoop Mills are to be modernised and improved at a cost of £150,000. An experimental pilot plant costing a further £60,000 is being installed to try out a process for continuous casting of steel billets. Owing to raw material shortages some workers may have to be displaced.

'Chemical Age' Index

The index to Volume LXIV of THE CHEMICAL AGE covering the period January to June, 1951, is now available. Those who require copies and have not already received them should apply to the Editor.

Change of Address

The Textile Institute announces that as from 10 August it's offices will be at 10 Blackfriars Street, Manchester, 3 (telephone: Manchester BLAckfriars 1457/8). The dining room and library will be open to members from that date. Meetings will probably continue to be held at present at 16 St. Mary's Parsonage, as the members' room, committee room, and lecture room are not expected to be ready for use before early in 1952.

Chemical Society Annual Reports

'The Annual Reports on the Progress of Chemistry (1950), Volume 47,' have recently been published at a price of 25s. by the Chemical Society. The Society has also published a cumulative index to Volumes 1-46 at the same price, which should serve as a comprehensive guide to all the subjects reported on in the first forty-six volumes of the annual reports and therefore to chemical progress from 1904-1949. It should greatly enhance the value of the reports. Volume 47 is, incidentally, the largest for ten years and compares favourably in size with the pre-war editions.

Purchase Tax Exemptions

The Treasury have made an order under Section 21 of the Finance Act, 1948. This order is entitled 'The Purchase Tax (No. 5) Order, 1951'—(Statutory Instruments 1951, No. 1357), and it revises and extends the list of essential drugs and medicines which are already exempt from Purchase Tax under another order entitled 'The Purchase Tax (No. 6) Order, 1950'—(Statutory Instruments 1950, No. 290). This is revoked. All drugs previously exempt under the revoked order remain exempt under the new order, except as they are mentioned in an explanatory note to the new order. Copies of all the orders can be obtained from any bookseller or the sales offices of HMSO.

OVERSEAS

Colombia to Develop Coal Deposits

An investment of 2,000,000 Pesos in the development of coal mining in the Magdalena department of Colombia through the Instituto de Fomento Industrial (the Industrial Development Institute) has recently been proposed; there are rich coal deposits on the borders of La Gusjina.

Australian Paint Industry

Demand for paint in Australia, created by the present active state of the building industry, has led to plans for the establishment of two new factories, to meet the requirements of the State of Western Australia. An established company is erecting a new plant which will make it independent of supplies of materials from other States. A second company has opened a new factory in Belmont, a suburb of Perth, the State capital. and is installing special blending equipment to meet the needs of the automobile industry.

Sweden's Sulphur Position

The Washington International Sulphur Committee has allocated to Sweden an import quota of 11,600 tons for the third quarter of the current year, although quarterly import requirements of the country total over 15,000 tons. As a result it is feared in Sweden that the important cellulose industry which accounts for 90 per cent of the total sulphur consumption of the country, will be affected and that an output of at least 150,000 tons of cellulose will be lost. Sweden's total annual sulphur requirements aggregate roundly 75,000 tons, of which the State shale oil works in Kvarntorp (Central Sweden) supply roughly 14,000 tons, thus leaving about 61,000 tons to be covered by imports. However, a marked expansion of domestic production of sulphur is reported to be taking place at present as a result of which productive capacity is to reach 28,000 tons by the beginning of 1952, thus, about 40 per cent of total requirements will be covered by domestic production. As regards supplies of pyrites, Sweden is far less dependent on foreign countries as home production is about 400,000 tons (*i.e.*, 80 per cent of requirements) and this is being expanded.

Australian Substitute for Linseed Oil

A new substitute for linseed oil for use by the paint industry, and in the manufacture of cosmetics, is to be used in Australia. Grape pips, a by-product of the wine industry, are to be processed under the direction of the Australian Wine Board to produce 50,000 gallons of oil annually. The processing will be carried out in the Barossa Valley, centre of the wine industry in South Australia. The company which will undertake the work has been making alcohol from waste grape skins, and stalks, for the past 21 years. Oil will be produced from 2,500 tons of pips a year.

Norway's Uranium Reactor in Operation

On 30 July the uranium reactor which Norwegian scientists and engineers have built at Kjeller near Oslo came into operation for the first time, and at 3.20 on the following afternoon the reactor produced its first radioactive isotope. Norway, Britain and France are the only countries in Western Europe possessing uranium reactors, and when the Kjeller reactor starts regular production of isotopes at the end of this year, it is hoped to supply the other Scandinavian countries and Holland and Belgium. The Norwegian reactor, claimed to be the cheapest so far built, cost under £1,000,000 including the heavy water and uranium. Attached to the reactor is a staff of 50.

Electrolytic Tin-Plate

Shortage of tin-plate for the food industry in Australia has led local manufacturers to investigate the use of electrolytic tin-plate to replace the true metal. Manufacturers will have to take a considerable proportion of their requirements in electrolytic tin-plate, which carries a very reduced coating of tin. This type of plate was used by certain countries in World War II, but was not commonly utilised by Australian manufacturers for wet pack foods. At present extensive research is being undertaken to ensure that if industry is obliged to take the electrolytic tin it can do so with confidence. The problem requires scientific determination of the variety of the lacquer necessary to replace the deficiency of tin coating for each category of food.

PERSONAL

MR. R. EDGEWORTH JOHNSTONE has left the A.P.V. Company, Ltd., and will join the Ministry of Supply as assistant director in the Directorate of Ordnance Factories.

MR. C. E. HORTON, C.B.E., M.A., has been appointed director of research to Fisons, Ltd. He was previously director of research to the Admiralty. Mr. Horton's headquarters will be at Harvest House, Ipswich, with laboratories at Bramford, Suffolk, and at Loughborough, and he will develop and co-ordinate the research activities of the whole company.

PROFESSOR T. P. HILDITCH, first holder of the Campbell Brown Chair of Industrial Chemistry at the University of Liverpool, who is retiring at the end of the present session under the age limit, has accepted an invitation from the directors of J. Bibby and Sons, Ltd., seed crushers, to become their consultant from 1 October next. The professor was last year made honorary vice-chairman of the Liverpool and North-Western Section of the Royal Institute of Chemistry of Great Britain and Ireland. Before going to Liverpool in 1926, Professor Hilditch, who is well-known for his work on the chemistry of natural fats, was chief research chemist to Joseph Crosfield & Sons, Warrington.

Two new appointments among their technical staff have just been announced by United Ebonite and Lorival, Ltd., of Little Lever, near Bolton. MR. G. F. SLY, formerly chief designer, has been promoted to the position of assistant to the works manager, MR. F. E. LOWE, and MR. J. KIRKPATRICK, formerly Mr. Sly's assistant, has been appointed chief designer in his stead. With five years' previous experience in the plastics industry, Mr. Sly joined Lorival in 1939 as tool designer responsible for the organisation of the drawing office, the tool room and tool control. In his new post, brought about by the continuing expansion of the company, he will be engaged mainly on administrative duties. Mr. Kirkpatrick joined Lorival straight from technical college at the age of sixteen, and was appointed assistant to Mr. Sly in 1949.

The honorary degree of LL.D. of the University of Aberdeen has been conferred on SIR WILLIAM OGG, director of Rothamsted Experimental Station, Harpenden, Herts.

SIR CLIVE BAILLIEU, Dunlop chairman, has been elected chairman of the English Speaking Union in succession to Lord Wakehurst. Princess Elizabeth is the union's president.

Leeds University has made the following appointments: DR. R. P. HULLIN, lecturer in biochemistry; MR. W. S. REITH, research chemist and honorary lecturer in the Department of Botany.

DR. F. N. WOODWARD, director of the Institute of Seaweed Research, was presented this week with a photograph of E. C. A. Stanford (1837-1899), one of the pioneers in chemical research on seaweed, by his daughter, to be hung in the institute near Musselburgh as a tribute to Stanford, who landed on the Isle of Tiree 90 years ago to establish a factory for extracting iodine from seaweed.

The following doctorates have been conferred in the University of London: MR. W. B. MANN (Imperial College of Science and Technology), D.Sc. Titile of Professor Emeritus in the University has been conferred on the following in respect of the chairs they have held at the colleges mentioned: PROFESSOR M. E. DELAFIELD (chemistry as applied to hygiene, London School of Hygiene and Tropical Medicine); PROFESSOR J. R. PARTINGTON (chemistry, Queen Mary College); PROFESSOR H. E. WATSON (Ramsay chair of chemical engineering, University College).

Obituary

The death is reported, at the age of 72, of MR. THOMAS BAINBRIDGE ALLISON, chairman and managing director of the Peerless Refinery Company, of Cheapside, Liverpool. Mr. Allison founded the company 30 years ago.

The Chemist's Bookshelf

CHEMICAL ENGINEERING COST ESTIMATION. By R. S. Aries and R. D. Newton. Chemonomics Inc., New York. 1951. Pp. 112. \$5.

Apart from articles in the journals *Chemical Engineering* and *Industrial Engineering Chemistry*, and sections of such American printed books as 'Chemical Engineering Economics' by C. Tyler and 'Engineering Economic Analysis' by C. E. Bullinger, there is almost no published information dealing with the method and technique of costing, chemical plant design and operation. There is in fact every reason to believe that except in a few large organisations which can afford to maintain departments specifically for this purpose, chemical costing in this country is at a very primitive level. The appearance of a book upon this subject should therefore arouse considerable specialised interest and speculation.

The copy examined was paper bound and had been printed directly from typescript by a photo lithograph process. The publishers are affiliated to an organisation called R. S. Aries and Associates, consulting engineers and economists, which itself publishes a news letter entitled 'Chemonomics'. A number of other books covering various economic aspects of the chemical process industry have been or are in the process of being published by Chemonomics Inc., several of them having been written by R. S. Aries who, in addition to his other activities, is Adjunct Professor of Chemical Engineering at the Polytechnic Institute of Brooklyn, N.Y.

In attempting to assess the value of this book to British technicians it is necessary to decide how much of the material is universal in application and how much is applicable only in the American field of operations.

The first 30 pages or so are devoted to the relation between the cost and size or capacity of various types of plant installations such as crystallisers, heat exchangers, dryers, etc. A series of graphs is given showing the relation between the cost in dollars and size of a unit. These graphs, while of great utility in their country of origin, have only the most indirect application here where the construction, labour costs, materials and currency are all different. The best use to be made of them is to copy the idea and to construct a similar series for British plant. On the other hand the section dealing with piping costs is particularly clear and precise and will be easily translatable despite the different sizes and costs of piping in this country. Chemical engineers will be interested in the 'Six Tenths' Factor Rule which states that the cost of a piece of equipment x times the capacity of another of known price is x 0.6 times that price, this rule being derived from the suggestion that the slope of a logarithmic plot of price against capacity is 0.6. Once again this approximation will need careful checking under British conditions.

The latter part of the book deals with capital investment estimates and the returns on invested capital and will therefore be of interest almost exclusively, at all but the theoretical level to the directors and those responsible for policy decisions. For this category the concept of 'Break Even' charts will probably be an engaging one.

To sum up, this is an excellent survey of the published information on chemical engineering costs but it should not be consulted in this country without due caution.—J.R.M.

LINEAR POLYMERS. By Elizabeth M. Frith and R. F. Tuckett. Dr. R. C. Pink, Chem. Dept., Queen's University, Belfast. Longmans, London. Pp. 355 18s.

No more striking evidence of the maturity of polymer science is to be found than the recognition, manifest in this useful book, that the fascinating chemistry of high polymers is rooted firmly in the classical physical chemistry of small molecules. In it are to be found, not details of the properties of individual polymers but general principles,

lucidly presented and graphically illustrated. Topics dealt with include methods for the determination of the structures of polymers, polymerisation phenomena and the physico-chemical properties of both polymer solutions and the solid polymers themselves.

Although references later than 1947 are absent this is not a formidable objection since the book deals mainly with well-established principles rather than factual detail. Full weight is given throughout to the thermodynamic approach, with perhaps an undue proportion of space allotted to the development of rather elementary thermodynamic principles. For many readers, however, whose enthusiasm for polymer chemistry is not matched by their prowess in thermodynamic argument, the authors' very lucid presentation of the necessary elementary thermodynamics will be a considerable convenience.

Since the authors combine industrial with academic experience it is not unexpected that due importance is attached to industrially important properties of the solid polymers. The chapter on this topic includes a useful discussion of modern theories of elasticity and relaxation phenomena together with accounts of plastic flow, viscosity and electrical properties. One of the fascinating aspects of modern theories of the structure of high polymers is the intimate connection which is revealed between their electrical and mechanical properties. Theory indicates that the hindrance to orientation of the carbon chains in a rapidly alternating electric field arises from exactly the same intermolecular forces which give rise to the characteristic polymer elastic effects and recent experimental work has shown a surprisingly good agreement between the electrical and elastic orientation times for the same polymer at a given temperature. While elaborating this picture the authors quite properly emphasise that, as yet, the theory permits only a qualitative description of the very complex effects which are met in practice. The analogous phenomenon of creep, for example, has so far resisted attempts to fit it satisfactorily into the theoretical picture.

This book is not for the specialist, who will seek his information in the reviews and the abundant polymer literature, nor is it for the undergraduate taking non-specialised courses in the university, but for those commencing research on any aspect of high polymers it will be invaluable.—R.C.P.

METHODS OF ANALYSIS OF FUELS AND OILS. By the late Dr. J. R. Campbell. Edited by William Gibb. Constable & Co., Ltd., London. Pp. xii, 216. Price 21s.

This book is a thorough practical treatise on the proximate and ultimate analysis of coal and oils (mainly fuel and lubricating) and gas. These and pyrometry the author succeeds in compressing into a small space without sacrificing clarity and completeness. Although the late Dr. Campbell wrote it for students, the expert too will find in it much useful and uncommon information and valuable improvements in routine determinations.

The book describes fully the determination of carbon dioxide, nitrogen, sulphur in various forms, chlorine, oxygen, phosphorus and arsenic. There are details of the assay of coal for carbonisation purposes and a most original chapter on coal cleaning and froth flotation on a laboratory scale which I do not remember having seen in any laboratory guide on coal. All types of pyrometers and their calibration are carefully treated. We miss our old friends the Seger Cones which years ago were a stand-by wherever only occasionally high temperatures had to be measured. For such cases Dr. Campbell has included the calorimetric method which is much more accurate, reliable and independent, although somewhat more troublesome.

Everything bears the stamp of having been carried out many times by himself personally and under his supervision. The reviewer performed many of these processes or their predecessors at the Royal Technical College, Glasgow, where the late Dr. Campbell taught and where many of these methods have been actually developed. Many now popular procedures described, even if invented elsewhere, were improved at the College by Professor Gray, Dr. Cruikshanks and Dr. King assisted by enthusiastic pupils and transferred into industry all over the world by a host of former students.

It is to be hoped that prospective buyers of this book will not be deterred by its small size and imagine they will get greater value in a bulky volume. It is superior to many large treatises in which the reader is frequently defeated by an ill-assorted collection of methods which may suffer from integral faults or from the lack of something in the description which makes all the difference between success and failure.—S.P.S.

Publications & Announcements

A NEW machine for the expression of liquors from high moisture-bearing materials is the Rosedowns G.X. expeller, a further addition to the range of expellers supplied by Rose, Downs & Thompson, Ltd., of Hull. Advantages of the new machine, which is described in Leaflet 47A now available, are claimed to be: the preliminary de-watering of materials which are to be dried, achieving considerable saving of steam and power in the subsequent drying operation; and the maximum reclamation of valuable liquors, including oils, which would otherwise be wasted. G.X. expellers at present being produced are mainly confined to the marine oil industries, but other applications will be exploited when conditions permit an increase in the numbers produced.

* * *

THE BRITISH Empire Cancer Campaign's 28th Annual Report, covering 1950, is a capacious tome of 394 pages, containing reports of all the activities of the various research centres working on cancer and related studies in the Empire. The increase in clinical research, cancer control and fundamental investigation in Canada and New Zealand, says the introduction to the report, is of particular interest. A comprehensive index to the authors of nearly 5,000 publications on carcinogenesis is now complete and it is hoped that this will be published this year. The report is an inspiring record of the steady progress of the British Empire Cancer Campaign.

VALVES for handling corrosive and abrasive slurries were first manufactured by Warren, Morrison, Ltd., some two and a half years ago. A new pamphlet has recently been issued by the company describing improvements incorporated in 2 in. size valve. These valves are the ultimate development of the laboratory clip principle. The flexible tube, usually of rubber, has end flanges which form the pipe joints and ensure the isolation of the fluid from the metal body. The body and closing mechanism are designed to support the tube which, therefore, becomes a flexible lining and does not have to withstand the fluid pressure over more than very small areas. Larger sizes in the new designs now close from the top and and bottom simultaneously, instead of from the top only as formerly.

* * *

PHOTOELECTRIC SWITCHES, timers and controllers make use of the electronic response obtained from a photocell resulting from variation or interruption of a light beam directed on its cathode. This response is amplified and used to operate a relay thus giving a very wide range of 'on-off' electrical control. A revised and increased range of its standard photoelectric equipment for industrial purposes has just been issued by Elcontrol, Ltd., as data sheet No. 5. Process and cyclic timers, cyclic interval switches are described in the company's data sheet D4 (issue 2), which has been extended and amended.

A cross counter current heat exchanger in the early stages of construction which was one of several used in a low pressure oxygen plant built in Europe by Petrocarbon, Ltd.

SULPHITE pulping properties of spruce wood from unpeeled, floated logs are described by Erich Adler, Department of Wood Chemistry, Swedish Forest Products Research Laboratory, Stockholm, in *Svensk Papperstidning* (Swedish Paper Journal, Vol. *54*, No. 13), official journal of the Swedish Paper Mills Association. In this part of his article, which is to be continued, the author deals with the catechol tannins in the surface layer of the sapwood.

* * *

STORAGE of acids and other industrial corrosive liquids in stoneware jars is widely recognised as one of the most efficient and economical methods. Bulk storage systems by Harthenware, Ltd., Loughborough, have been installed for handling sulphuric, hydrochloric, nitric, phosphoric, acetic and formic acids, also for hypochlorite and various other bleach liquors. The company's new catalogue, Section 5—' Acid Storage Plants' is now available, and marks the first occasion that a section has been devoted to dealing comprehensively with stoneware jar storage systems. A table is given as a guide to typical storage plants of various sizes.

* * *

A NEW refractory—Morgan M.R.1 is announced by the Morgan Crucible Co., Ltd., in its leaflet R.D.30, recently issued. Approximate chemical analysis of the refractory is: silica 52/53 per cent; alumina 43/44 per cent; iron oxide (Fe_2O_3) less than 1 per cent; magnesia less than 1 per cent; lime, potash, and soda about 1.5 per cent. It is pointed out that alumina content has long been the recognised basis in assessing the quality of a firebrick. In the case of Morgan M.R.1 the use of selected high quality materials, together with the specialised method of manufacture has resulted in a product whose chemical structure is entirely different, and therefore this refractory should not be assessed in terms of alumina content. Morgan M.R.1 is fired at a temperature that ensures volume stability under all conditions of normal loading at temperatures up to 1,600°C. Softening under load does not commence until 1,600-1,650°C.—10 per cent subsidence taking place at 1,750°C. The chemical composition and physical make-up ensure a strong resistance to slag attack. Despite its density the constitution of M.R.1 is such that resistence to thermal shock is of a high order.

JUST published by 20th Century Electronics, Ltd., is a small brochure on Geiger counter tubes and cathode ray tubes, giving the specifications of both. As well as standard counter tubes quenched with ethyl formate, the pamphlet includes details of a new range of halogen quenched, low voltage tubes, and also the improved version of the 20th Century Double Gun C.R. Tube. The brochure can be obtained on request from the company.

* * *

APPLICATIONS for grants for the Research Fund of the Chemical Society will be considered in November next, and should be submitted not later than Thursday, 1 November 1951. Fellows will be given prior consideration.

The Research Fund provides grants for the assistance of research in all branches of chemistry. About £700 is available for this purpose annually, the income being derived from a donation of the Worshipful Company of Goldsmiths, from the Perkin Memorial Fund, and from other sources.

Forms of application together with the regulations governing the award of grants may be obtained from the General Secretary, The Chemical Society, Burlington House, Piccadilly, London, W.1.

* * *

THE report of the Productivity Team on Freight Handling, which visited America recently under the auspices of the Anglo-American Council on Productivity has lately been released. General conclusions reached are that the vast scale of transport operations and the higher wages in the U.S.A. greatly increase the scope for using mechanical equipment and large road and rail vehicles. In methods of freight handling there is no startling differences between British and American standards, says the report, as this type of work does not lend itself to typical American mass-production methods. There are, however, important variations in technique, and in the attitude of mind towards mechanisation (the Americans are far more machine-conscious). Larger consignments in America, and hence greater potential saving in labour costs favour higher mechanisation, and American labour in the transport industries is normally paid on a time-basis instead of, as in most of Britain, on a piece-work basis. Copies of the report may be obtained from the Council, price 2s. 6d.

n-
er
ng
as
yl
a
t-
of
e.
st

ch
n-
be
n-
n-

or
of
is
d
y
al

ne
ts
y,
e,

n
a
o-
s
n-
s-
e
g
d
l-
n
e
d
n
t
e
e
).
e
s
n
-
s
s.
n

11

Commercial Intelligence

The following are taken from the printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described herein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages or Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

ACTID, LTD., London, W.C., chemical products merchants, etc. (M., 11/8/51.) 6 June, £14,500 debenture, to H.M. Treasury Solicitor; general charge. £18,000, 11 January, 1951.

HOGGETT YOUNG & CO., LTD., London, N., makers of acetylene welding and cutting plants. (M., 11/8/51.) 11 June, mortgage, to Midland Bank, Ltd., securing all moneys due or to become due to the Bank; charged on 43 Essex Road, N., and fixtures. *Nil. 8 November, 1950.

LOUIS HOLT (CHEMICALS), LTD., Enderby. 12 June, charge, to Westminster Bank, Ltd., securing all moneys due or to become due to the Bank; charged on factory premises and land at Brook Street, Enderby, and fixtures. *Nil. 29 March, 1950.

Satisfactions

ALLEN & HANBURYS, LTD., London, E., manufacturing chemists, etc. (M.S., 11/8/51.) Satisfaction 14 June, of debentures registered 7 June, 1933 (fully), of supplemental charge registered 24 September, 1935, and of debenture registered 29 April, 1950.

H. G. PILLING (CHEMISTS), LTD., Manchester, (M.S., 11/8/51.) Satisfaction 21 June of mortgage registered 31 December, 1935.

Increases of Capital

The following increases of capital have been announced: BOOTS PURE DRUG CO., LTD., from £4,000,000 to £8,000,000; LOCKETT AND HOWARD (CHEMISTS), LTD., from £6,500 to £10,000; SCOTT, BADER AND CO., LTD., from £10,000 to £50,000; SMITH AND HALL (CHEMISTS), LTD., from £40,000 to £80,000; A. BOAKE ROBERTS & CO., LTD., from £537,500 to £1,000,000; OPTREX, LTD., from £60,000 to £100,000.

Company News

The Morgan Crucible Co.

A favourable outlook is revealed in the preliminary statement of the Morgan Crucible Co. for the year ended 31 March. Group profits after all charges but before taxation are up by 34 per cent to a record of £1,517,000. Even after an increase of £312,000 in the tax charge the net figure is £70,000 higher at £614,000. A final dividend of 8¾ per cent is recommended, making a total for the year of 12½ per cent, less tax.

Market Reports

LONDON.—The shorter week and seasonal influences have made for quieter conditions in the industrial chemicals market. Never-the less the demand has been good and a substantial volume of business is waiting completion as supply conditions permit. Price movements have been few and where changed are higher, as for instance acetone and copper sulphate, which have advanced by £25 per ton and £8 per ton respectively, and which were received too late for last week's report. There is no change in the position of coal tar products.

MANCHESTER.—A number of chemical-consuming concerns in the textile and other industries in Lancashire and the West Riding of Yorkshire have been closed for the past week for annual holidays. Nevertheless the slackness usually expected at this time of the year has been less in evidence than usual on the chemical market, and fairly active conditions have prevailed. Soda, potash and ammonia compounds have met with a steady demand and good deliveries were being taken of the barium compounds. Fertilisers were quiet in most sections, but there was a continued trade in the tar products.

GLASGOW.—The past week has certainly been an extremely busy one and manufacturers and merchants alike have been hard pressed to meet the demand for the usual run of general chemicals and with the number of orders on hand all sections of the trade will be kept extremely busy for some time to come.

There is not much change in the export market, but inquiries for a number of products are now coming forward for the first time in many years.

Steel Consumers' Council

NAMES of the members of the Iron and Steel Consumers' Council, set up under the Iron and Steel Act, 1949, have now been announced. The council was established to consider any matter, including prices, affecting the interests of consumers.

The following appointments have been made by the Minister of Supply (Mr. G. R. Strauss):—

Independent Chairman: Sir William Palmer, K.B.E., C.B. Council members: Sir Amos Ayre, Mr. Ralph Bennett, Mr. A. L. Shuttleworth, Sir Andrew McTaggart, Mr. C. M. Spielman, Mr. Robert Arbuthnott, Mr. W. Moray Lines, Mr. W. D. Wilson (representing iron and steel consuming industries).

Mr. M. C. Wade, Mr. J. W. Annetts, Mr. H. Basil Darby (representing iron and steel merchants and stockholders), Mr. W. B. Beard, Mr. J. Tanner, Mr. F. Hayday (representing workers in consuming industries); Sir John Hacking, General Sir Daril G. Watson (representing nationalised industries).

In accordance with the terms of the Act, the Iron and Steel Corporation of Great Britain have nominated Sir John Green and Mr. W. H. Stokes, two of its members, to serve on the council.

The Minister has decided after consultation with the appropriate organisations, that the private section of the iron and steel industry shall not at present be represented on the Consumers' Council. These organisations will continue to discuss problems of common interest directly with the Iron and Steel Corporation of Great Britain.

The following additional members of the Iron and Steel Consumers' Council, have been announced: Sir Harry Railing (General Electric Co., London); and Mr. R. G. D. Ryder (Thomas Ryder and Sons, Ltd., Bolton); both represent iron and steel consuming industries.

Offices of the Council will be at 1 Chester Street, London, S.W.1.

International Allocations

Now that tungsten, sulphur and molybdenum have been equitably rationed out by the Materials Conference, there is widespread confidence in Washington that further scarce materials will be under control by the end of this year. Allocations for newsprint, nickel and cobalt, and perhaps, for copper and zinc, are virtually assured for the fourth quarter of this year, with manganese and lead as less likely prospects, report officials in Washington.

CLASSIFIED ADVERTISEMENTS

SITUATIONS VACANT

A **YOUNG MAN** with a Science Degree is required to fill a new position in the Technical Sales Department of a progressive Chemical Manufacturing Company situated in S.W. Lancashire. The duties will include liaison between the Company's Research and Commercial Departments involving technical service matters and development work. For the successful applicant, the position is permanent and is covered by a superannuation scheme. Letters of application should be marked "Technical Sales," and state age, qualifications, experience, etc., to Box No. C.A. 3033, THE CHEMICAL AGE, 154 Fleet Street, London, E.C.4.

APPLICATIONS are invited for the post of **SHORT-HAND-TYPIST & CLERICAL WORKER** in the advertisement department of THE CHEMICAL AGE. Five-day week. Staff canteen, etc. Apply in writing to **The Secretary, Benn Brothers Ltd., 154 Fleet Street, E.C.4.**

OIL Refinery Contractors handling large contracts for refinery plant require **CONTRACTS ENGINEERS** in their London office. Duties involve broad direction and co-ordination of all phases of the work, including planning, drafting, purchasing, progressing and erection. Desirable qualification is previous experience, including a wide knowledge of pumping, heat exchange equipment and instrumentation, and the appointments offer excellent prospects to suitable men. Applicants should write fully, stating qualifications, age and experience to **Foster Wheeler, Ltd., 3 Ixworth Place, London, S.W.3.**

TECHNICAL ENGINEER required by the Division of Atomic Energy (Production), Risley, nr. Warrington, to undertake fundamental technical work in the application of engineering principles to the design of nuclear reactors and allied atomic energy projects, and to predict the performance of such plants.

Candidates must have a good Honours Degree and have had post-graduate experience on original work in applied thermodynamics, heat transfer and fluid flow, or power plant design, chemical engineering or allied fields.

Salary will be assessed according to qualifications and experience within the ranges £997-£1,192 p.a., or £720-£960 p.a. A house should be available within a reasonable period for the successful candidate, if married. Voluntary contributory superannuation scheme. Applications to **Ministry of Supply, D.At.En.(P), Risley, Nr. Warrington, Lancs., stating post applied for.**
RS.7888-25-8MP.

SERVICING

ALL CHEMICALS AND DYESTUFFS can be repacked for export by **The East London Chemical Warehouse Co. Ltd., New Barn Street, Abbey Arms, Plaistow, London E.13.**

CRUSHING, GRINDING, MIXING and DRYING for the trade.
THE CRACK PULVERISING MILLS, LTD
Plantation House,
Mincing Lane,
London, E.C.3.

GRINDING of every description of chemical and other materials for the trade with improved mills. THOS. HILL-JONES, LTD., "Invicta" Mills, Bow Common Lane, London, E. Telegrams: "Hilljones, Bochurch, London," Telephone: 3285 East.

FOR SALE

600

FILTERS & FILTER PRESSES

13 Imperial **VACUUM CONCENTRATION FILTERS,** type 2, with washing equipment. Drum approx. 13 ft. by 8 ft. 3 in. diam., approx. 320 sq. ft. filtering surface. Complete immersion of filter drum. Fitted double pendulum agitator, filtrate and wash water receivers, filtrate pump, mud pump. Drive through spur reduction gear from 4-speed gearbox.

15 twin unit **KELLY FILTERS** by Dorr Oliver, cap. of each twin unit 1900 galls., and filter surface approx. 1080 sq. ft. Pressure approx. 75 lb. sq. in., 20 filter frames in each unit, some clothed with Monel metal filter fabric. Filters mounted in fabricated steel frame with mechanically-operated chain mechanism for removal of filter frames. Overall length of twin filter, 40 ft.

Unused **FILTER PRESS CARCASE** by Johnson, wooden plate and frame type, suitable for 34 chambers giving cap. 101.7 cu. ft., frame size 61 in. by 49 in., cake size 48 in. by 38 in. by 2 1/16 in. With rubber-lined filtrate trough.

GEORGE COHEN SONS & CO., LTD.
SUNBEAM ROAD, LONDON, N.W.10
Tel: Elgar 7222 and
STANNINGLEY, NR. LEEDS
Tel.: Pudsey 2241

CHARCOAL, ANIMAL and VEGETABLE, horticultural, burning, filtering, disinfecting, medicinal, insulating; also lumps ground and granulated; established 1830; contractors to H.M. Government.—THOS. HILL-JONES, LTD., "Invicta" Mills, Bow Common Lane, London, E. Telegrams, "Hilljones, Bochurch, London," Telephone 3285 East.

"CHEMICALS, PIGMENTS, METAL POWDERS," **DOHM, LTD.**, 167, Victoria Street, S.W.1.

'PHONE 98 STAINES

COPPER Jacketed **VACUUM PAN, CONDENSER** and **ELEC. VACUUM PUMP,** by "Blair Campbell," with pan 7 ft. by 3 ft. diam.

W.S. **AUTOCLAVES,** all lengths up to 18 ft. by 2 ft. diam., 100 lbs. w.p.

Unused 5-stage **TURBINE PUMPS**—350 ft. hd., 167 g.p.m.

"Simon" **DRYER,** revolving tube unit, 90 sq. ft. approx.

Twin "Z" and "V" blade jacketed **TIPPING MIXERS,** also cylindrical and "U" trough **MIXERS** in stock.

HARRY H. GARDAM & CO. LTD.
STAINES

STORAGE VESSELS
Lancashire Boiler Type
Two—30′ × 7′ 6″ diam.
Two—28′ × 7′ ,,
One—28′ × 8′ ,,
Two—26′ × 7′ ,,
One—23′ × 5′ 6″ ,,
One—20′ × 5′ ,,
One—18′ × 5′ ,,
Dish Ended Type
One—Riveted, 28′ × 7′ 6″
One—Welded, 28′ × 8′
MADEN & McKEE LTD.
317, PRESCOT ROAD, LIVERPOOL, 13.

FOR SALE

VARIOUS MIXERS FOR SALE

BAND CONVEYOR, 50 ft. long 40 in. wide, steel frame motorised, for boxes, cases, bags, etc.

Two **FILTER PRESSES** fitted with wood plates and frames, washing type.

Two **FILTER PRESSES,** chamber type, steam heated, centre fed with separate outlet taps.

14 various open top **STORAGE TANKS,** riveted capacities from 300 gallons to 9,800 gallons, last used for oil or varnish.

1½, 2½ and 3½ size belt-driven **DISINTEGRATORS** by Christy & Norris or Harrison Carter.

Size No. 3 Junior Hammamac **HAMMER MILL** with fan and cyclone, also No. 1 size Miracle **GRINDING MILLS** and one size 3W Miracle **GRINDING MILL.**

Robinson 3-sheet No. 1 size **CENTRIFUGAL DRESSING MACHINE** for dry powders, etc.

Gardner Size "G" **RAPID SIFTER** and **MIXER,** belt and gear driven.

Two Gardner **RAPID MIXERS** only, 40 in. long, 14 in. wide, one provided with small separate A.C. Motor.

Four **ROTARY BOWL MIXERS,** 5 ft. diam., cast iron built, inclined agitators, by Baker Perkins.

One Broadbent under-driven **HYDRO EXTRACTOR** self-balancing type, with self-contained A.C motor.

Two **FILTER PRESSES,** fitted recessed C.I. plates, 40 in square, 2½ in. thick, centre fed, to make 11 cakes per Press.

Kek **GRINDING MILL,** square pin type, with grinding discs 13 in. diam., including circular delivery bin with single outlet.

Large unjacketed **WERNER MIXER,** belt and gear driven, hand tipping, double "Z" arms, pans 53 in by 45 in. by 36 in. deep.

No. 200 One nearly new **WERNER PFLEIDERER JACKETED MIXER OR INCOPORATOR.** Low type, with C.I. built mixing chamber, 28 in. by 29 in. by 27 in. deep, with double "U"-shaped bottom which is jacketed, and double fish-tail or fin-type agitators geared together at one side, with belt-driven friction pulleys, 34 in. diam. by 5 in. face, with hand-wheel operation and hand-operated screw tilting gear. Machine fitted with machine-cut gears covers, gear guard, cast-iron baseplate, and measuring overall approximately 7 ft. by 6 ft. by 4 ft. high to the to of the tipping screw.

No. 200 One **HORIZONTAL "U"-SHAPED MIXER** steel built, riveted, measuring about 8 ft. 3 in. long by 3 ft. wide by 3 ft. 3 in. deep, with horizontal shaft, fitted with bolted-on mixing arms about 18 in. long by 4 in. wide, with intermediate breakers, and driven at one end by a pair of spur gears, with countershaft, fast and loose belt pulleys, outer bearing and plug cock type outlet at the opposite end, mounted on two cradles fitted to two R.S.J. running from end to end.

Further details and prices upon application

Write **RICHARD SIZER LIMITED, ENGINEERS, CUBER WORKS, HULL**

LABORATORY TEST SIEVES TO B.S 410 : 43 or commercial quality, ring or write for brochure.
ENDECOTTS (FILTERS) LTD., 251, KINGSTON ROAD, LONDON, S.W.19. LIBERTY 8121/2.

FOR SALE

MORTON, SON & WARD LIMITED
—OFFER—
HYDRO EXTRACTORS

TWO 72-in. and one 60-in. by **BROADBENT,** all electric, under driven steel galvanised baskets.

TWO 42-in. by **WATSON LAIDLAW,** all-electric, under driven through vee ropes from flange-mounted vertical spindle motor.

TWO 36-in. and one 30-in. by **BROADBENT,** all-electric, under driven through vee ropes, steel baskets.

All above suitable for 400/3/50 supply and complete with cabinet starters.

JACKETED PANS

THREE new 100-gallon, mild steel, mounted on three legs, suitable for working pressure of 100 lb. p.s.i.

TWO 300-gallon, mild steel, suitable for 50 lb. p.s.i.

TWO 450-gallon, mild steel, suitable for 50 lb. p.s.i.

All above can be fitted with stirring gear.

TWO 300-gallon, mild steel, **JACKETED AUTOCLAVES.**

NUMEROUS all bronze, brass tube, **HEAT EXCHANGERS** or **CONDENSERS** in stock.

We **SPECIALISE** in all types of **MIXING EQUIPMENT.**

Enquiries invited
MORTON, SON & WARD LIMITED,
WALK MILL,
DOBCROSS, NR. OLDHAM,
Lancs.
'Phone : Saddleworth 437

½ OZ. **CANNONS** for sale. Also 12 oz. 14 oz., 22 oz. and 26½ oz. **GLASS BOTTLES** also 40 oz. **WINCHESTESR** and 1 gallon **STONE BOTTLES** and all other capacities. Wooden packing **CASES. T. Gunn (Rayleigh), Ltd., 206, London Road, Rayleigh, Essex. 'Phone Rayleigh 87.**

3 M.S. Welded Jacketed **PANS,** 24 in. diam by 26 in. deep, 1½ in. bottom outlet, mounted on angle legs.; Tested 100 lb. hydraulic pressure.

THOMPSON & SON (MILLWALL) LIMITED
CUBA STREET, LONDON E.14.
Tel.: East 1844

8 COPPER-jacketed **MELTING PANS,** 18 in. diam. by 12 in. deep, fitted covers. mounted in M.S. frames 25 in. by 25 in. by 44 in. high, with flanged fittings, valves and steam traps. As new.

THOMPSON & SON (MILLWALL) LIMITED
CUBA STREET, LONDON, E.14.
Tel. East 1844

WANTED

URGENTLY required. Hardinge **BALL MILL,** size 6 ft. by 22 in., or nearest. Complete with grinding media. Box No. C.A. 3031, THE CHEMICAL AGE, 154 Fleet Street, London, E.C.4.

URGENTLY wanted. **TWO**—Twin Roll **DRUM DRIERS,** having rolls approx. 3 ft. diam. by 8 ft. 6 in. long, suitable for steam at 100 lb. per sq. in. Box No. C.A. 3032, THE CHEMICAL AGE, 154, Fleet Street, London E.C.4.

PATENTS & TRADE MARKS

KING'S PATENT AGENCY, LTD. (B. T. King, A.M.I.Mech.E., Patent Agent), 146a, Queen Victoria Street, London, E.C.4. ADVICE Handbook, and Consultation free Phone: City 6161.

Printed in Great Britain by THE PRESS AT COOMBELANDS Ltd., Addlestone, and published by BENN BROTHERS LTD., at Bouverie House, 154, Fleet Street, E.C.4, 11 August, 1951. Registered at the General Post Office. Entered as Second Class Matter at the New York, U.S.A., Post Office.